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OF THE MAGELLANIC FUND.

SECTION 1. John Hyacinth de Magellan, in London, having in the year 1786 offered to the Society, as a donation, the sum of two hundred guineas, to be by them vested in a secure and permanent fund, to the end that the interest arising therefrom should be annually disposed of in premiums, to be adjudged by them to the author of the best discovery, or most useful invention, relating to Navigation, Astronomy, or Natural Philosophy (mere natural history only excepted); and the Society having accepted of the above donation, they hereby publish the conditions, prescribed by the donor and agreed to by the Society, upon which the said annual premiums will be awarded.

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1. The candidate shall send his discovery, invention or improvement, addressed to the President, or one of the Vice-Presidents of the Society, free of postage or other charges; and shall distinguish his performance by some motto, device or other signature, at his pleasure. Together with his discovery, invention, or improvement, he shall also send a sealed letter containing the same motto, device or signature, and subscribed with the real name and place of residence of the author.

2. Persons of any nation, sect or denomination whatever, shall be admitted as candidates for this premium.

3. No discovery, invention or improvement shall be entitled to this premium, which hath been already published, or for which the author hath been publicly rewarded elsewhere.

4. The candidate shall communicate his discovery, invention or improvement, either in the English, French, German, or Latin language.

A GRAMMAR OF THE CAKCHIQUEL LANGUAGE OF GUATEMALA.

Translated from a MS. in the Library of the American Philosophical Society, with an Introduction and additions,

By Daniel G. Brinton, A.M., M.D.,

One of the Secretaries of the Society.

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Introduction.

§ I. *The Cakchiquel Nation.*

The Cakchiquel language was, and continues to be, spoken by the natives in the vicinity of the city of Guatemala. It is a dialect of the Maya group of languages, and is very closely related to the Kiche and Tzutuhil dialects, and more remotely to the Chorti, Mam, Pokomam, Ixil, Pokonchi and Kekchi, all yet extant in that part of Central America.

At the time of the Conquest, the Cakchiquels were divided into two States under the senior and junior branches of the same reigning house. The capital of the elder branch was called *Pitinamit*, The City, *par excellence*, or *Iximche*, the name of a tree, a species of *Brosimium*, fam. *Artocarpeaceæ*, but it received from the Aztec invaders the name *Tecpan Guatemala*, The Royal House of Guatemala, by which it is usually entered on modern maps. The junior branch had its seat at Zololá, situate on a lofty summit north of Lake Atitlan, a site called by the Aztecs, *Tecpan Atitlan*, the Royal House of Atitlan.* The whole of this district is elevated, and the climate temperate; but there were also a few Cakchiquel colonies in the hot lands near the Pacific Coast, as at Patulul, Cozumelguapam (celebrated for the inscribed slabs lately discovered there) and other places. Here they were in immediate contact with the Pipiles, of Aztec descent, and speaking a slightly corrupted Nahuatl dialect.

As the city of Guatemala was founded in the midst of a Cakchiquel-speaking population, this language early attracted the attention of the missionaries. The first bishop, Francisco Marroquin, appointed to the See in 1534, was himself an earnest student of the tongue, and secured the publication of a doctrinal work in it. When in 1678 the University of Guatemala was formally founded, a chair of the Cakchiquel language was created, the first occupant of which was Fr. José Senoyo, a Dominican. In 1743 Guatemala was raised to the dignity of an Archbishopric, and thereafter it was customary to call the Cakchiquel "the metropolitan tongue," *la lengua metropolitana*, or *la lengua Guatemalteca*. It was regularly taught in the University until the dissolution of the political dependence of Guatemala on the Spanish Crown (1822), since which event, I be-

*For the full explanation of these and other Nahuatl names found in Guatemala, see Buschmann, *Ueber die Aztekischen Ortsnamen*, § VIII.

lieve, no Professor of Cakchiquel has been appointed, and no systematic instruction given in the tongue.

The meaning of the name *Cakchiquel* is obscure. A passage in Herrera gives it the translation, "eagle," with the explanation that it was the name of the site on which the city of Guatemala was founded, and was derived from the custom of the war chief of that nation carrying an eagle as a banner.* The dictionaries, however, do not support this derivation. Evidently Herrera's informant took the name from *cakix*, the ara or guacamaya, *Trogon splendens*, a bird of beautiful plumage, held sacred by most of the Central American tribes. But the derivation is too violent.

The root *cak* means "red," or more correctly, something red; *chi*, is mouth, literally and metaphorically, hence speech, language, dialect; and in such proper names as Pokonchi, Kakchi, etc., it apparently has this latter signification, as the dictionaries translate *Cakchiquelchi* by "the Cakchiquel language." The last syllable *quel*, has been translated "stone," though I do not find this form in the dictionaries, but only the allied ones, *qual*, a term applied to all precious and supposed medicinal or sacred stones, such as were used for amulets, and *qeley*, brick, a connection strengthened by the adoption by some writers of the form *Cakchiqel*.† Dr. Berendt suggested that the three syllables could thus be fairly translated, "The Red Mouth of the Rock," or mountain; the reference being to the active volcanoes whose fiery outbursts have so often desolated that region, and which we know were regarded and worshiped with superstitious veneration.

The natives, however, derived their name from a mythical tree, the *caka chee*, or red tree, which they brought with them from Tullan, their ancient home beyond the sea. This is expressed in the following sentence from the *Annals* of Xahila:

"Xa ka hun chi caka chee ka qhamey ok xoh pe xi qo ka qama pe chu chi Tullan, quereqa ka binaam vi Cakchiquel vinak."

The *Cakachee* is now the name of one of the dye woods which grow in Guatemala.

I have said the language was called *Cakchiquelchi*, and they spoke of

*"La ciudad de Santiago de Guatemala, cuio sitio llamó Cachequil, que significa Aguila, porque el General de esta Nacion, quando salia à la Guerra, llevaba un Aguila por Penacho, etc." Herrera, *Descripcion de las Indias Occidentales*, Cap. XII.

†The anonymous dictionary of the Cakchiquel, lately in the possession of Mr. E. G. Squier, usually gives this form.

themselves as *ahcakchiquels*, but generally by the simpler term *Cakchiqueles*.

II. *History of the Present Work.*

The present Grammar of the Cakchiquel is the translation of a portion of a Spanish manuscript presented to the Library of the American Philosophical Society in 1836, by Señor Mariano Galvez, then Governor of Guatemala, and obtained, it would appear, from the library of one of the religious houses. I have described this MS. in a previous publication, and will transcribe what I have there written :

"The next work is a small quarto of 109 leaves. Unfortunately, the first leaf with the general title is missing. The top of the second leaf commences in the midst of a sentence in a *Doctrina Christiana* in Cakchiquel. This covers ten leaves, and is followed by two leaves of 'Preguntas de la Doctrina,' all in Cakchiquel. Next comes a 'Confessionario breve en lengua Cakchiquel.' The Spanish translation of each question and answer is also given.

"After the Confessionario are three leaves, unnumbered and blank, except that on the recto of the second is a Latin Prayer to the Virgin, difficult to decipher.

"On the recto of the next leaf is the following :

"'*Arte* || *de la lengua cak* || *chiquel.*'

"It is written in a clear small hand, covers fifty-four pages, with an average of thirty lines to the page, sometimes with one column, sometimes with two, and closes with the colophon :

"'Martes á 24 de Junio de 1692 años dia del Nacimiento de S. Juan Baptista se acavo el traslado de oraçiones y Arte en Kakchiquel.'

"From the close of this to the 96th leaf there is another series of doctrinal questions in Cakchiquel.

"Then follows another 'Confessionario breve en lengua castellana y cakchiquel,' 12 pages in length, differing considerably from the previous one. The rest of the volume is taken up with 'Platicas,' short discourses on religious subjects. * * The characters of Parra are employed in all the divisions of the book, and the writing is generally quite legible.

"There is no hint throughout where the original was written nor by whom. * * * The linguistic value of the *Arte* is considerable."*

As no part of the collection presented to the Society by President

* *A Notice of Some Manuscripts in Central American Languages*, by Daniel G. Brinton, *American Journal of Science and Arts*, March, 1869.

Galvez, has ever been published, it was resolved at a meeting toward the close of 1883 to have this short grammar translated and printed, and the task was referred to me.

A close examination of the MS. showed that the copyist had not been always accurate, sometimes failing in a consistent orthography, and once or twice having manifestly neglected the observance of the proper order of the original. Where there was no doubt about such negligence, it has been corrected in the translation; but elsewhere the original has been adhered to, even when another disposition of the subject seemed preferable to the translator.

Fortunately, the exhibition of the language could be rendered more satisfactory by the aid of two manuscript grammars in my own library. One of these is that of Fray Benito de Villacañas, a Dominican who died at the Convent of Guatemala in 1610, at the age of 73 years, and who for more than thirty years had been a missionary among the Cakchiquels. His knowledge of the language, therefore, dated back to the first century of the Conquest, and his works represent it in its primitive form. The second Grammar is by Fray Estevan Torresano, and was written shortly after the publication in 1753 of the Cakchiquel Grammar of P. Ildefonso Joseph Flores, and with the especial object of improving and correcting that unnecessarily complicated and ill-arranged book. Torresano's is, I believe, the latest grammar of the Cakchiquel which has been composed, as that of Villacañas is the earliest now in existence, and they therefore offered particularly useful aids in this undertaking.

All these grammars take as their plan that of the Latin or Spanish languages, and apply it to this American dialect. To scientific linguists it is needless to say that this method is quite erroneous, and that it forces American tongues into a form wholly uncongenial to their spirit. But it would have been impossible to have adopted any better system, and at the same time to have maintained the semblance of a translation. Therefore, I have confined myself to an obedience of the plan chosen by the authors I had to follow, trusting that the material furnished for the study of the language will be sufficient to allow the linguist to complete a scheme of its organization and to arrange its elements in accordance with the demands of modern science.

III. *Literature of the Cakchiquel Language.*

The Maya group of languages, of which, as I have said, the Cakchiquel is a member, has several points of peculiar interest. It was the linguistic

expression of one of the most cultivated indigenous races on the continent; it was, and still is, maintained with a singular tenacity; it is largely composed of monosyllabic or dissyllabic roots; and its grammatical construction presents a marked contrast to that of its near neighbor, the Nahuatl (Aztec), and still greater to the native tongues of the United States with which we are most familiar, the Algonkin, Iroquois, Dakota, Muskoki, Cherokee, etc., by its very much more pronounced analytic tendency. The latter trait prevails through all its dialects, though more obviously in some than in others. Especially for the latter reason its examination is important to students of languages, as indicating the feeble development of polysynthesis in an American tongue.

Moreover, the Cakchiquel has been, as I have above intimated, one of the most thoroughly studied of native languages. There is a large body of theological literature extant in it, and several semi-historical works by native writers. Very little of this has been printed. So far as I know the following memoranda show all that has been put to press.

1556. According to Remesal, *Historia de Chiapa y Guatemala* (Lib. III, Cap. VII), there was printed at Mexico in this year a *Doctrina Christiana*, in "the Utlateca language commonly called the Quiche," by order of the first Bishop of Guatemala, Fray Francisco Marroquin. Remesal adds, "although the title of the book sets forth that the work was accomplished with the aid of the friars Juan de Torres, and Pedro de Santos (read, Betanzos), of the Franciscan and Dominican orders respectively, yet this was owing to the humility of the Bishop, who could readily write in the native tongue without their aid, but who was anxious to have the terms used in the translation satisfactory to both orders."

Although no copy of this edition is known to exist, I have no doubt that Remesal was in error when he said that the above work was in the Utlateca or Kiche dialect. Elsewhere he himself says it was in "the language of the country" (*la lengua de la tierra*), which, with reference to Guatemala, would undoubtedly mean Cakchiquel. But the most conclusive evidence is the following title from a work, evidently another edition of the above:

1724. Doctrina Christiana en lengua Guatemalteca: Ordenada por el Reverendissimo Señor Don Francisco Marroquin primer Obispo de Guatemala, y del Consejo de su Magistad, y con parecer de los interpretes de

las Religiones del Señor Santo Domingo y S. Francisco: Frai Juan de Torres y Frai Pedro de Betanzos.

Fronting the above:

Christianoil tzih pa Cakchiquel, qhabal, releçan ahau Obispo Francisco Marroquin; nabei Obispo Cakchiquel, ru poponel Emperador. Qui hunam vach erah cakchiquel chi Santo Domingo Santo Francisco, Padre Frai Juan de Torres, Frai Pedro de Betanços.

Colophon:

En Guatemala con licencia de los Superiores, por el B. Antonio Velasco, 1724.

The volume is small 4to, 32 unnumbered leaves, the first 30 in two columns, Spanish in the first, Cakchiquel in the second. The 1st and 2d leaves contain a "Prologo" in two columns, Spanish and Latin; leaves 31 and 32 contain a Declaration of Faith, Act of Contrition, and a Prayer, all in one column and in Cakchiquel only.

The only copy known of this work is in a private collection in Guatemala, and the description given above is from Dr. C. H. Berendt's notes, taken from the book itself. It is not mentioned by any of the bibliographers. I think the title leaves no doubt but that it is a reprint of the *Doctrina* referred to by Remesal, and that he was in error in speaking of it as in the Kiche.

1753. Arte de la Lengua Metropolitana del Reyno Cakchiquel ô Guatemalico, con un Paralelo de las Lenguas Metropolitanas de los Reynos Kiché, Cakchiquel, y Zutuhil, que hoy integran el Reyno de Guatemala. Compuesto por el P. F. Ildefonso Joseph Flores, hijo de la Santa Provincia del Dulcissimo Nombre de Jesus de Guatemala, de la Regular Observancia de N. Seraphico P. S. Francisco, Ex-lector de Phylosophia, Predicador, y Cura Doctrinero por el real Patronato del Pueblo de Santa Maria de Jesus. En Guatemala, por Sebastian de Arebalo, año de 1753. Small 4to, pp. 387.

I take the above title from Squier's *Monograph of Authors who have written on the Languages of Central America* (New York, 1861). The work has now become very scarce, although about half a dozen copies are known to be extant in private hands.

1840. M. Ternaux-Compans in his *Vocabulaires des Pricipales Langues du Mexique*, published in the *Nouvelles Annales des Voyages*, Tome IV, printed about 500 words of the Cakchiquel, taken from an anonymous

MS. dictionary in the National Library, Paris, and accommodated to the French orthography.

1857. Extracts in the original with a French translation from the "Manuscript Cakchiquel ou Memorial de Tecpan-Atitlan" in Brasseur de Bourbourg, *Histoire des Nations Civilisées du Mexique et de l'Amérique-Centrale* (Paris, 8vo). Two pages, in two columns, French and Cakchiquel. The Abbé frequently referred to this document and considered it, with reason, one of the most important extant on the pre-Columbian history of America as well as for its great linguistic value. It was the work of a native Cakchiquel noble, Francisco Ernantez Xahila, who wrote most of it about 1570, and after his death it was continued by a relative, Francisco Gebuta Queh.

1862. Cartilla Breve traducida en Lengua Quiche y Cakchiquel al pié de la Letra para el uso de los Cristianos Indigenas. 2 pp. Pp. VII and VIII of the *Grammaire de la Langue Quichée*, by the Abbé Brasseur de Bourbourg (Paris, 8vo, 1862). The orthography is brought into conformity to French types. The Abbé does not give the origin of this piece. The same volume contains a comparison of the three dialects, Kiche, Cakchiquel and Tzutuhil, and a Vocabulary of Roots common to the three, both derived from the works of Father Francisco Ximenez.

With the exception of a few unimportant vocabularies, by Galindo, Scherzer, and others, and the discussion of the Cakchiquel in general works on language, such as those of Hervas, Pimentel, Lucien Adam, etc., the above includes all the printed material relating to the tongue known to me.*

I should not omit, however, to mention the interesting studies in comparative grammar, which have been made with reference to it and its allied dialects by M. Hyacinthe de Charencey. His observations are based on a critical and conscientious analysis of the hitherto accessible materials, and are aided by an extensive acquaintance with the idioms of the Old World. The articles he has published, and which I name in a note, throw more light on the structure and relations of the whole group of languages

* Since the above was in type, I have received Dr. Otto Stoll's excellent monograph, *Zur Ethnographie der Republik Guatemala* (*Zurich*, 1884), in which, pp. 129-158, he gives a grammatical sketch of the modern Cakchiquel as spoken in the vicinity of San Juan Sacatapequez. He also adds many words and phrases in the tongue.

to which the Cakchiquel belongs, than the production of any other philologist whose writings I have met. Those who would use the present grammar to the best advantage should acquaint themselves with these essays of M. de Charencey.*

The following alphabetic list contains a brief reference to all the writers and works which have been produced in Guatemala in or upon this tongue :

ALARCON, BALTASAR DE. Flourished 1600.

Franciscan. Collected a volume of sermons written in Cakchiquel by various members of his order. In the Brasseur collection.

ALONZO, JUAN. Flourished about 1550.

Native of Guatemala (?). Dominican. Composed a *Calepino* or Dictionary of the Cakchiquel, yet extant.

ANGEL, FR. About 1700.

Franciscan. A Grammar and Dictionary attributed to him were in the Brasseur collection.

BETANZOS, PEDRO DE. † 1570.

Native of Spain. Franciscan. Composed a Grammar and Vocabulary of the Cakchiquel, and prepared, assisted by Juan de Torres, the *Doctrina* printed at Mexico 1556, and Guatemala, 1724, described above.

CORRAL, FELIPE RUIZ. † 1636.

Native of Guatemala. Prepared a Grammar and Vocabulary of the Cakchiquel for the use of the priests.

COTO, TOMAS. Franciscan, 17th century.

Native of Guatemala. He is the author of *Vocabulario de la Lengua Cakchiquel vel Guatemalteca * * En que se contienen todos los modos y frases elegantes con que los Naturales la hablan*, folio, 475 leaves, 2 cols. MSS. in the library of the American Philosophical Society. It is complete down to the word *vendible*, but the last few leaves are missing.

* *Sur les lois phonétiques dans les idiomes de la famille Maya-Quiché.*
Sur le pronom personnel dans les idiomes de la famille Maya-Quiché.
Sur le système de numération chez les peuples de la famille Maya-Quiché.
Recherches sur les noms de nombres cardinaux dans la famille Maya-Quiché.
Sur la langue dite Mame ou Zaklo-pakap.
These are included in *Mélanges de Philologie et de Paleographie Américaines par le Comte de Charencey*, Paris, Ernest Leroux, 1883, except the last two, which are later and separate publications. I am glad to add that we may expect shortly from the same competent hand a thorough analysis of the verb in this linguistic group.

DELGRADO, DAMIAN.

Order of Preachers. Prepared a Grammar and Dictionary of the Cakchiquel.

FLORES, ILDEFONSO JOSEPH. †1772.

Native of Guatemala. Franciscan. Professor of Cakchiquel in the University of Guatemala. Wrote the only published Grammar of the tongue, which has already been described.

GUZMAN, PANTALEON DE. Flourished 1700.

Order of Preachers. Cura of Santa Maria de Jesus Pache. Wrote a *Thesaurus Verborum* and a *Doctrina*. A copy of these is in my possession.

HILLON, JOAN DE.

Dominican. "Maestro gravissimo y mui gran lengua." *Coto.* His works are not known.

IRONDO, JUAN FRANCISCO.

Native of Guatemala. Franciscan. Wrote in Cakchiquel an *Exposicion del Simbolo de San Atanasio.*

MALDONADO, FRANCISCO. Flourished 1640.

This minorite friar wrote a *Ramillete, manual para los Indios sobre la Doctrina Christiana,* and an *Explicacion de la Doctrina Christiana,* copies of both of which, made in 1748, are in the library of the American Philosophical Society, in folio. He is frequently quoted by Coto for the purity of his style.

MARROQUIN, FRANCISCO. †1563.

Native of Spain. Franciscan. Bishop of Guatemala, 1533 to 1563. Was the first to reduce to writing the Kiche language. Wrote a Cakchiquel Grammar, and ordered the preparation of a *Doctrina* in that tongue by the Brothers Betanzos and Torres. See above.

MENDOZA, JUAN. †1619.

Native of Mexico. Franciscan. Wrote a *Doctrina,* Lives of the Saints, and Doctrinal Sermons in Cakchiquel.

ORDOÑEZ, DIEGO. 1490–1607 (?).

Born in Spain. Franciscan. Said to have been the first to reduce the Cakchiquel to writing. Composed in it a *Doctrina* and a number of sermons.

PARRA, FRANCISCO DE. †1560.

Native of Spain. Franciscan. Devised the five peculiar characters

of the Cakchiquel alphabet, and composed a trilingual vocabulary of Kiche, Cakchiquel and Tzutuhil.

PAZ, ALONZO. † 1610.

Native of Guatemala. Franciscan. Taught Cakchiquel and wrote in it a work entitled *Scala Cali*, frequently quoted by Coto as an authority.

QUEH, FRANCISCO GEBUTA. 1580.

A native Cakchiquel. Wrote a continuation of the Annals of Xahila, q. v.

RODRIGUEZ, JUAN.

Native of Spain. Franciscan. Composed a Grammar and Vocabulary of the Cakchiquel.

SALCEDO, FRANCISCO.

Native of Chiapas. Franciscan. Professor of native languages in the University of Guatemala. Wrote a Grammar and Dictionary of the Cakchiquel.

SAZ, ANTONIO.

Native of Chiapas. Franciscan. Wrote Sermons in Cakchiquel and an improved Grammar called *Manual en la Lengua*. Also *Manual para los Casados*. His works are often quoted by Coto as models of style.

SOTOMAYOR, PEDRO. † 1631.

Native of Guatemala. Franciscan. Wrote a Grammar, Vocabulary and Sermons in Cakchiquel.

TORRES, JUAN DE. Flourished about 1550.

Native of Spain. Dominican. Assisted by Pedron de Betanzos, he prepared, by order of Bishop Marroquin, the *Doctrina* in Cakchiquel, subsequently printed.

TORRESANO, ESTEVAN. Flourished 1750.

Native of Guatemala. Wrote an improved Grammar of the Cakchiquel, described above. A copy is in the national library of France, and another in my collection.

VAREA, FRANCISCO. Flourished 1600.

Native of Spain. Franciscan. Wrote a *Calepino* or Dictionary of Cakchiquel, a copy of which, made in 1699, by Fray Francisco Çeron, is in the library of the American Philosophical Society. Squier in his *Monograph* erroneously gives his name as *Varela*. The volume is small 4to, 239

leaves in all, closely written, and gives the translation of about 4000 Cakchiquel words.

VICO, DOMINGO. †1555.

Native of Spain. Order of Preachers. Composed a Grammar and Vocabulary of the Cakchiquel, and in it some sacred poems, and the celebrated *Theologia Indorum*. A copy of the latter is in the library of the American Philosophical Society.

VILLACAÑAS, BENITO DE. †1610.

Native of Spain. Dominican. Wrote a Grammar and Dictionary, both preserved, and copies of both are in my collection.

VILLEGAS, ANTONIO PRIETO DE. 17th century.

Commissary of the Holy Office. For thirty years *beneficiado* of Matzatenango. Thoroughly versed in Kiche. Wrote *Tratado sobre el Baile Lotztun. Coto.*

XAHILA, FRANCISCO ERNANTEZ ARANA. †15(?).

A native writer. Composed the Annals of his nation, the so-called *Memorial de Tecpan-Atitlan.* Copy in the Brasseur collection and another in mine.

XIMENES, FRANCISCO. Flourished 1710.

Native of Spain. Dominican. Wrote a Catechism and Confessionario in Cakchiquel, and a Comparative Grammar of the three dialects, printed by Brasseur de Bourbourg. See above.

To the above should be added various anonymous productions and those whose authors are unknown. Among the last mentioned is the work now printed, to the authorship of which I have obtained no clue.

In the National Library at Paris there is a fine 4to MS., of 202 pp., in Cakchiquel, dated 1553, said to be a translation of the Pentateuch (?). That library also possesses an anonymous *Vocabulario en lengua Castellaña y Guatemalteca*, a recent copy of a much older work.

I have in my library a *Calendario de los Indios de Guatemala*, 1685, in Cakchiquel, a copy of an original in the city of Guatemala, and I have heard of other written calendars in various parts of that country.

§ IV. *Phonology of the Cakchiquel.*

The Spanish missionaries complained of the idioms of Guatemala as excessively rough and guttural, *con asperisima pronunciacion gutural*, as the

historian Juarros says.* Nor do they seem to impress recent travelers of other nations more agreeably. One of the latest of these, an Englishman, writes: "When an Indian speaks, it is always in a high, unmusical tone; the language is hideous, and sounds like a person speaking without any roof to his mouth."†

In the present work, as in most that have been written in or upon the Cakchiquel, the phonetic basis is the Spanish alphabet. Of that alphabet the following letters are used with their Spanish values, a, b, c, ç, e, i, l, m, n, o, p, q, r, t, y, z.

The following are not employed:

d, f, g, j, s, tt, ñ.

The following are introduced, but with sounds differing from the Spanish:

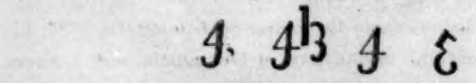
h. This is always a decided rough breathing or forcible expiration, like the Spanish j, or the strong English h; except when it follows c or q when it is pronounced as in the Spanish *cha, che*, &c.

k. This has never the sound of c, but is a rough palatal, the mouth being opened, and the tongue placed midway, between the upper and lower walls of the oral cavity, while the sound is forcibly expelled.

v. This letter whether as a consonant (*v*) or a vowel (*u*) is pronounced separately, except when it is doubled as in *vuh* (*uuh*), book or paper, when the double vowel is very closely akin to the English *w*. The Spanish writers are by no means consistent in their orthography of the Cakchiquel, in distinguishing the vowel *v* and the consonant *v*.

x. In Cakchiquel and its associated dialects, this letter represents the sound of *sh* in the English words *she, shove*, etc. It is of very frequent occurrence in all of them.

Besides the above, there are five sounds occurring in the Cakchiquel, Kiche and Tzutuhil, for which five special characters were invented or rather adopted by the early missionary Francisco de la Parra, who died in Guatemala in 1560. They are the following:



* He adds, "y que con solo pronunciar con mas ó menos fuerza las palabras mudan de significado." *Compendio de la Historia de la Ciudad de Guatemala.* Per el Pr. Don Domingo Juarros, Tomo II, p. 36 (2d ed. Guatemala, 1857).

† *Across Central America.* By J. W. Boddam-Whetham, p. 264 (London, 1877). The particular dialect he refers to is the Kekchi of Coban in Vera Paz.

The origin and phonetic value of these are as follows:

This is called the *tresillo*, from its shape, it being an old form of the figure three, reversed, thus, ȝ. It is the only true guttural in the language being pronounced forcibly from the throat, with a trilling sound (*castañeteando*).

From its shape this is called the *cuatrillo*, Parra having adopted for it an old form of the figure 4. It is a trilled palatal between a hard *c* and *k*.

The name applied to this is the *cuatrillo con coma*, or the 4 with a comma. It is pronounced somewhat like the c with the cedilla, ç, only more quickly and with greater force—*ds ordz*.

This resembles the "4 with a comma," but is descibed as softer, the tongue being brought into contact with the teeth.

A compound sound produced by combining the quatrillo with a forcible aspirate is represented by this sign.

Naturally, no description in words can convey any correct notion of these sounds. To learn them, one must hear them spoken by those to the manner born.

Unfortunately, there is no uniformity about the use of Parra's signs among the writers in Cakchiquel. Of the considerable number of Cakchiquel MSS. I have examined, I find scarcely two alike in this respect. Most of them use the *tresillo* and the *cuatrillo*; some discard all of them; and but few fully carry out the scheme he suggested. The writers differed in nicety of ear, and the same word occurs written in more than one way.

In the printed works no special type has been obtained to imitate these characters. I have some recent publications from Guatemala in the Kiche dialect where the figure three reversed, ȝ, and the figure 4, are employed in the type to represent the tresillo and cuatrillo.* Brasseur used a *g*, and introduced hyphens and apostrophes in his editions of Kiche writings, but these were all foreign to his original manuscripts, and cannot therefore be approved by exact scholarship.

I think there are sound objections to using Arabic numerals to express

* I refer to some songs, etc., in Kiche, published in *El Federal Indiano. Quincenario de antiguedades históricas, costumbres indígenas i jeneralidades*, published at Totonicapam, 1883, by the eminent Guatemalan linguist and antiquary, Señor Don Manuel G. Elgueta.

phonetic elements (though I am aware it has obtained in books printed in Iroquois), and I agree with those who advocate employing rather the European alphabets with diacritical marks. In the present work, therefore, I have concluded to adopt for the tresillo the somewhat similar Greek sigma Σ; and for the cuatrillo the full-faced q, this having, indeed, the authority of Varea in his *Calepino* and also of the native writers, Xahila and Queh, who use a modification of this letter for the cuatrillo of Parra. The *cuatrillo con coma* is then readily represented by a full-faced q, with a comma, and thus the necessary phonetic distinctions are observed without going beyond the resources of an ordinary printing office, and without presenting to the reader figures or signs which he cannot possibly connect with any sounds whatever.*

* On the general subject of the phonology of the dialects under consideration, the student will find the best information in Dr. C. H. Berendt's essay, *An Analytical Alphabet for the Mexican and Central American Language*, (New York, 1869, published by the American Ethnological Society); and in Dr. Otto Stoll's work, *Zur Ethnographie der Republik Gautemala*, pp. 40-44. The description given in the text of the peculiar sounds is taken from that in Torresano's Grammar.

GRAMMAR OF THE CAKCHIQUEL LANGUAGE.

Chapter I. Of the Noun.

Declension of Nouns.

The first matter which it is necessary to discuss is the declension of the Noun. In this language there is no declension of cases, as in Latin, as the singular serves for all cases of the singular, and the plural for all cases of the plural. The following rules will explain which nouns have plurals, and which have not:

¶. Every noun which signifies an inanimate thing lacks the plural; as *abah*, stone, *che*, wood, stick, *vleuh*, the earth.

¶. Every noun which signifies an animate thing without other relation or any accident,* has no plural. Such are generic and specific names, as, *chicop*, animal or brute, *tziquin*, bird *queh*, horse,† *balam*, tiger.

¶. An exception is *yxok*, the female, which makes *yxoki*, the females, and *balam* which is found with the plural *balami*, the tigers.

¶. It is to be noted with reference to these rules that when such nouns are united to the primitive or derivative pronouns of the plural number, then they have a plural, not in expression but in signification. For example, *mani kochoch*, we have no houses; q*o kapop*, we have mats.

¶. When any of the above nouns are united to the primitive or derivative pronouns, in metaphorical expressions, praising or blaming, then they have the plural form; as, *yx quere aΣe*, you are like hens; *yx quere balami*, you are like tigers.

¶. The nouns referred to in the above two rules also have a plural by union with words signifying plurality, as q*ij*, much, *conohel*, all, and with the ordinal numbers; as q*uiyache*, many sticks, *oxivay*, three loaves, *tzatchi vinak*, many people.

* Here used in its metaphysical sense.

† Properly "deer."

¶. Names of animate things which signify an accident of nature as "the young," "the old," etc., or of fortune as "the poor," "the rich," and also participial nouns form their plural by adding to some *a*, and to others *y*; but which termination is to be added must be taught by use. Examples, *mama* the old man, *mamae*, old men; q*ahol*, the youth, q*ahola*, youths; *aqual*, the child, *aquala*, children; *ala*, the boy, *alabon*, boys; *Σopoh*, the girl, *Σopohiy*, girls; *Σinom*, rich, *Σinoma*, rich people; *meba*, poor, *mebai*, poor people.

¶. Nouns ending in *n* or *m* form their plural in *a;* as *ahticon*, the owner of a cacao plantation, plural, *ahticona; ahtziçom*, a tailor, plural, *ahtziçoma.*

¶. Participial nouns ending in *a* form their plural by adding *y;* as *ahtzeola*, the rower, *ahtzeolay*, the rowers; *ahloΣola*, the buyer, *ahloΣolay*, the buyers; *ahpitzola*, he who makes works in feathers, *ahpitzolay* feather-workers. There are some adjective nouns which have a plural form, as *nim*, great, plural, *nimak; chutim*, small, plural, *chutik.* To express that a road is lofty or extended, one would say in the singular *naht*, large or extended or distant, and in the plural *nahtik; nima ya*, a great river; *chuti ya*, a small river or small rivers.

This particle *he* or *e* added to the noun forms a plural, as, *zah he qui Σu*, they have white clothing.

The Grammars of Villacañas and Torresano give some farther particulars of plural forms. The general rule is that nouns denoting inanimate objects have no plurals, and those denoting animate objects are pluralized either by the terminations *a* or *i* (= *y*), or by the use of words conveying plurality. Of the latter the most common is *he* or *e*, which is simply the plural demonstrative pronoun, these or those. This pronoun is also inserted even when the noun has the plural termination, as *Xe be he ah*q'*aki chi cochoch*, the plasterers went to their houses. It carries with it a specific and definite meaning, and is omitted even with animate nouns without plural forms when these are employed in a general sense. Torresano shows this by the following two examples: *conohel he nu*q*ahol xe be pa caman*, all my sons have gone to the village cornfield; but, indefinitely, *ronohel vinak xe be pa camah*, all the people have gone to work.

There are also a number of nouns signifying animate objects which are used absolutely, without the pronominal prefixes, and which may be pluralized by prefixing the *e*. Of these are *tata, tataatz*, or *tataixel*, the father, not stating whose, q*ahol*, q*aolatz* or q*aolaxel*, the son, not stating whose,

hi, *hiatz*, or *hiaxel*, the son-in-law. These approximate to verbal forms, and appear to be confined to nouns indicating family affinity.

Abstract nouns may be constructed by adding the termination *ah* to the concrete. They do not form plurals, but contain the notion of plurality. Thus, *nu tzam*, is "my nose," but *tzamah*, is "the nose," without reference to person. So Σ*a*, hand, *nu* Σ*a*, my hand, Σ*abah*, the hand, which also means the two hands, as they are always associated in nature.

§ I. *On the Use of Adjectives.*

The adjective noun is always placed first, and then the substantive noun, and between adjective and substantive is placed one of the following particles, which by themselves have no signification:

a,—*y*,—*ilah*,—*olah*,—*lah*,—*ah*,—*olah*,—*vlah*,—*elah*.

Examples: *nim*, large, *nima che*, large stick; q*ij*, much, q*ija çaΣul*, much fruit; *çak*, white, *çaki* q*ul*, white cloak; *naht*, high, *nahtik vinak*, great persons; *vtz*, good, *vtzilah ya*, good water; q,*il*, dirty, q,*ilolah* q*ul*, a dirty cloak; *meΣen*, hot, *meΣenalah ya*, hot water; *chaom*, pretty, *chaomalah Σopoh*, a pretty girl; *teu*, cold, *teulah ya*, cold water; q*ay*, bitter, q*aylah ya*, bitter water; *ytzelulah huyu*, a bad descent; *loΣ*, beloved, *loΣolah tata*, beloved father; *chu*q,*huh*, maimed, *chu*q,*huhilah ahauh*, a maimed ruler; *xche*, sterile, *xcheelah yxok*, a sterile woman.

¶. Other words add *ic*, as q*ulan*, joined or married, q*ulanic yxok*, a married woman; *hebel*, something pretty and pleasant, *hebelic* q*ul*,* pretty clothing.

¶. Note that when one substantive noun is united to another substantive noun, with the signification of an adjective, one of these particles, *alah* or *ylah*, is placed between them; as *abahilah bei*, a stony road; *gixalah huyu*, a thorny mountain; *chicopilah vinak*, a bestial person.

¶. The particles *elah* and *vlah* are also placed between such substantives, as q,*echelah ticon*, a cacao field neglected and overgrown; *civanilah bei*, a rough road.

¶. And take notice that the least important substantive is placed first, and used as the adjective; as, *gix*, a thorn, *bei*, a road, *gixalah bei*, a thorny road.

*The generic word for clothing is q*ul*; the specific term is Σ*u*; the latter is varied, the former is not. (Coto.)

¶. Observe that when any derivative or possessive pronoun is united to the first noun in such a connection, then one of the following particles is added to the noun, *al, el, il, ol, vl;* as, *ahauh*, lord, *rahaual vinak*, the lord of the people; *ru yaal bohoi*, the water of the jar; *ru cheel hai*, the wood of the house, *ru çaΣulil che*, or *rua che*, the fruit of the tree; *ru bakil balam*, the bone of the tiger; *ru bohoil cab*, the jar of the honey; *ru popol hai*, the rug of the house. And this is not only the case with third persons, but with all persons, both singular and plural, as:

vahaual Jesu Christo, My Lord Jesus Christ.
auhaual Jesu Christo, Thy " " "
rahaual Jesu Christo, His " " "
kahaual Jesu Christo, Our " " "
yahaual Jesu Christo, Your " " "
cahaual Jesu Christo, Their " " "

To make the above explanation clearer, it should be stated that in Cakchiquel, as in most American tongues, there is no such separate part of speech as an adjective. The word *nim*, does not mean "great," but "a great thing;" *hebel*, "a pretty thing," etc. Such words only assume the sense of adjectives when used to express the quality of a subject. Hence the Spanish grammarians divide the Cakchiquel nouns into the two classes, "adjective nouns," such as the above, and "substantive nouns," which can express being without relation.

Of the terminations *alah, elah, ilah, olah, ulah*, Torresano states that the most frequent are *alah* and *ilah*, as these may be added to almost all nouns, both substantive and adjective; *olah* is used only in the word *loΣolah*.

On the terminations *al, el, il, ol, vl*, Villacañas has the following important remarks: "The possessive pronouns unite with both substantive and adjective nouns, and it is to be noted that when the pronoun convcys the notion of ownership, no termination is added to the noun; but when the pronoun expresses the connotation of a quality or accident, and not ownership, then one of the following particles is added to the nouns, *al, el, il, ol, vl*. For example, *nu uh*, my book, the book which I own; *nu uhil*, my book, that in which matters relating to me are written; *nu colob*, my cord, the cord I own, *nu colobol*, my cord, the cord with which I am bound, etc. When these particles are added to adjective nouns, they express the quality in the abstract, as *zac*, white, *zacil*, whiteness; *vtz*, good, *vtzil*, goodness. These abstract nouns can rarely be used with the personal possessive pronouns, although we might say, *nu zacil*, my whiteness."

Chapter II. Of the Pronouns.

¶. There are primitive and derivative pronouns. The primitive are:

yn, I.	*oh*, we.
at, thou.	*yx*, you.
ha,* that one.	*he*,† these.

Other pronouns are: *yn, at, ha, oh, yx, here.*

Genitives of these words are:

vichin, my or of me.	*kichin*, our.
avichin, thy.	*yvichin*, your.
rrichin,‡ of that one.	*quichin*, their.

Datives of these genitives:

chuichin, to or for me.	*chikichin*, to or for us.
chavichin, to or for thee.	*chivichin*, to or for you.
chirichin, to or for that one.	*chiquichin*, to or for those.

The following are datives of the same sense and rendering.§

chue, to or for me.	*chike*, to or for us.
chaue, to or for thee.	*chive*, to or for you.
chire, to or for that one.	*chique*, to or for those.

Accusatives of these words:

chuih, against me.	*chikih*, against us.
chavih, against thee.	*chivih*, against you.
chirih, against that one.	*chiquih*, against those.

Those words also mean, of or from me, of or from thee, etc.

Torresano adds the explanation: "This accusative has two other significations (besides the one given above). One is 'at my cost,' or 'in my care,' as, 'It is in my care to aid you and to look after you,' *Chuih* q*ohvi ytooiç iq'eti navipe.* The other is, 'behind me,' 'behind thee,' as, 'The garment is behind thee,' *Chahvih* q*oh vi* q*ul.*" So Coto gives the example: *Chuih ahilam vi ri*, "This is at my cost or expense."

* Should read *ri*; *ha* is the demonstrative.

† Or, *e*.

‡ Better, *richin*.

§ This form is not given by either of the other grammarians.

In the reciprocal accusative Torresano doubles the terminal vowel, and also adds another form as follows:

chinubil vij, within myself.
chabil avij, within thyself.
chubil rij, within himself.
chikibil kij, within ourselves.
chibil ivij, within yourselves.
chiquibil quij, within themselves.

It is used as in the following example: *qa mahaniok tuinakiricah Dios cah vleuh xaki chubil rij xqohe vi*, Before God created the heaven and the earth He was within Himself. The term *bil* is here used with the possessive pronoun and the preposition *chi*.

In reference to vocatives the same author remarks that they have no peculiar form in this language, and that in place of them they use the second persons, singular and plural, as, *Yx alabon*, Boys, come here (literally, You, boys).

The following accusatives are used in the present tenses:

quin, me.
cat, thee.
koh, us.
quix, you.
que, them.

There are other accusatives which are used to form reciprocal verbs, *e. g.*, *tin loΣoh vi;* I love myself; and thus in the other persons prefixing the particles *tin*, *ta*, *tu*, as:

tin—vi, to myself,
ta—avi, to thyself.
tu—ri, to himself.
tika—qui, to ourselves.
ti—ivi, to yourselves.
tique—qui, to themselves.

The ablatives are:

vumal, by or from me.
aumal, by or from thee.
rumal, by or from that one.
kumal, by or from us.
yumal, by or from you.
cumal, by or from those.

There are other ablatives which signify, with me, with thee, etc., to wit:

viquin, with me.
aviquin, with thee.
riquin, with that one.
kiquin, with us.
yviquin, with you.
quiquin, with those.

¶. Possessive pronouns or particles to distinguish the pos-

session of the object; these are, for nouns beginning with a vowel:

v, my.	*k*, our.
av, thy.	*iv*, your.
rr, that one's.	*c*, their.

Thus, *vochoch*, my house, *avochoch*, thy house, *rochoch* that one's house, *kochoch*, our house, *yvochoch*, your house, *cochoch*, the house of those. And in this same way many other nouns are declined, as *vahauah*, my lord, *vahtih*, my master, *vetam*, I know or am acquainted with, an expression used to signify that one knows or understands some art.

The following particles are used with words beginning with a consonant:

nu, my.	*ka*, our.
a, thy.	*y*, your.
ru, of that one.	*qui*, of those.

As, *nuvach*, my face; *avach*, your face; *ruvach*, his face; *kavach*, our face; *yvach*, your face; *quivach*, their face. In the same way the following and many other words are declined:

nutata, my father.	*nuqux*, my heart.
nute, my mother.	*nuquicotem*, my joy.
nuΣahol, my son.	*nughahomonel*, my wash-woman.
numial, my daughter.	*nuhalon tzih*, my false testimony.
nuyavabil, my sickness.	*nutzih*, my word.
nutzik, my clothing.	*nupixa*, my word.
nuqazlibal, my soul.	*numac*, my sin.
nuqazlem, my life.	

All the following nouns are declined by these particles *v* and *nu:*

nunimial, my elder brother.
nuchaΣ, my younger brother.
vana, my sister.
numama, my ancestor.
vatit, my ancestress.

numam viy, my grandchild.
vican nutata, my uncle.
nute, vana, nutata, my aunt.
vicoΣ, my nephew or niece.
qechan, or *nubaluc*, my brother-in-law.
vixnam, my sister-in-law.
vali or *valibatz*, my daughter-in-law.
nu hinam, my father-in-law.
nuhite, my mother-in-law.
nuchaΣ nunahti nimal, my male cousin.
nunahti ana, my female cousin.
nuchi, my son-in-law.
nuyahtata, or, *nutata bal*, my stepfather.
nuyahte, or *nutebal*, my stepmother.

¶. The women say among themselves:
nuxibal, my elder brother.
nughuti xibal, my younger brother.
nunimal, my elder sister.
nuchaΣilatz, my younger sister.
valinam, my father-in-law.
valite, my mother-in-law.
nunahti xibal, my male cousin.
nunahti numal, my female cousin.

The women call the nephew *val* and the niece also, and to know if it is a son or not one asks: *Kitzih pe aval?* Is it really thy son? If it is she says: *Val;* and if not, *Ralqual nuxibal*, it is the son of my brother; and of the niece, *Rumeal nuxibal. Aval pe?* Is it thy son, or thy daughter? She replies, *Val*, my son.

The following table from Villacañas and Coto exhibits the terms of consanguinity and affinity as used by the two sexes:

	By males.	By females.
my son	*nu qahol*	*val*
my daughter	*nu mial*	*vixokal*
my elder brother	*nu nimal*	*nu xibal*
my younger brother	*nu chaΣ*	*nu qhuti xibal*
my elder sister	*vana*	*nu nimal*

	By males.	By females.
my younger sister	*nu* q*huti vana*	*nu nimalatz*
my spouse	*vixhaïl*	*vachahiil*
my father-in-law	*nu hinam*	*valinam*
my mother-in-law	*nu hite*	*valite*
my brother-in-law	*nu baluc, nu hi*	*vechanim*
my sister-in-law	*vixnam*	*vali*
my son by a former marriage	*nu yah* q*ahol*	*nu yah al*
my daughter by a former marriage	*nu yah mial*	*nu yah ixok al*
my male cousin	*nu chaΣ*	*nu nahti xibal*
my female cousin	*nu nahti ana*	*nu nahti nimal*
my grandson	*nu mam*	*viy*
my granddaughter	*nu mam*	*viy*

Many of these are compound words, whose meanings are easily reached; *nimal* is from *nim* or *nima*, large, great; *ghuti*, is small, little; *ixok*, female; *xibal*, male; *yah*, the organs of generation of either sex (*nu yah* q*ahol* = the son of my body); *naht* or *nahti*, remote, distant. *Baluc* and *hi* do not mean brother-in-law in our sense, but are applied to all males of the *chinamitl* or *gens* into which the speaker has married. The general word for parentage is *aca*, which is used as in the following sentence: q*oh pe aca quichin qui chiquibil qui vac* q*ulubel?* Is there any relationship between these who are about to marry?

The terms given as used by women only do not in any manner indicate a different linguistic origin. It will be seen that several of them are from the word *al*, used above for son and daughter (*ixok al* = *female al*); this is a form from *alan*, to bring forth, to give birth to, and is no doubt connected with *al*, a load, a burden, as in English we say of a pregnant woman, "She is carrying." These terms, therefore, must be considered specializations of relationship which are used only by the women because they are from points of view, which, in the nature of things, are peculiar to that sex. Strictly speaking, they are not linguistic peculiarities at all.

These particles, *ri*, *ha*, *hari*, mean "this;" as *ta bana ri*, do this. *Ha* may be used demonstratively as in this sentence, *Ha tahox tiban avumal*, This is proper, that it be done by you. It may also be used for *ille*, *illa*, *illud;* as: *Dios xbana cah vleuh xaviha xbano ronohel* q,*etom maqui* q,*etom* (*tzetom*). God made the heavens, the earth, and He made all that we see and do not see. The particle *hari* may stand for *iste*, *ista*, *istud*, as in this example: *Hari vae tzih tavi tibijx chivichin kitzih chi loΣ*, These words which I speak to you are truly precious. It may also be used for *ipse*, *ipsa*, *ipsum*, as, *Mixcam ri Pedro*,

Pedro has died. *Nakchi Pedro?* Which Pedro? *Hari xa q,et pa bei*, The one you saw in the road.

Other compositions are made with these pronouns in the following manner:

xavi yn ri, I myself.	*xaviohri*, we ourselves.
xavi at ri, thou thyself.	*xavyxri*, you yourselves.
xavi ha ri, that one himself.	*xaviheri*, those themselves.

The following particles carry with them a notion of benefit or of injury. I give an example of benefit: *Xax in vi tool yvichin*, I am the same ally to you as heretofore. Of injury: *Xax in vi agutel*, I am your opponent.

xax in vi, I the same.	*xax oh vi*, we the same.
xax at vi, thou the same.	*xax ix vi*, you the same.
xax ha vi, that one the same.	*xax he vi*, they the same.

Another composition: *vae* means the same as *ecce*, behold; as, *Vae nutzih*, Behold my words; *Vae amac*, Behold your sin.

yn vae, I the same.	*oh vae*, we the same.
at vae, thou the same.	*yx vae*, you the same.
ha vae, that one the same.	*he vae*, those the same.

Thus it is used by one who knows himself and humbles himself: *Yn vae inqazhol, in macol*, I, that same evil sinner.

Another composition is:

yn va, behold me here.	*oh va*, behold us here.
at va, behold thee here.	*yx va*, behold you here.
ha va, behold him here.	*ha va*, behold them here.

As: *Yn va in ahauh*, Behold me here, me, a lord; it is used in pointing out, in this manner, greatness, or wisdom, or strength, or pride.

The particle *ha* placed at the beginning of a sentence corresponds with *vae;* as, *Ha bin ya chavichin vae tin ya*, This is what I have to give you.

Quis vel Qui. Who.

Nak and *chinak* signify "who." *Nak ca tux?* Who art thou? *Nak?* Quid est? *Nak achock ychin ri?* or, *Nak ah*

ychin ri? Whose is this? *Nak pe ah ychin?* or, *Nak pe* **q***o rrichin ri?* Whose is this? Or, To whom does this belong? *Nak chiquichin?* To whom? *Nak chiquichin xtin ya vi?* To whom am I to give it? or, To which of them?

Nak chinak, whom or what, to or in whom or what. *Nakchinak chirih* **q***o vi ri mac?* In whom is this sin? *Nak chinak xa camicah?* Whom or what have you killed?

Distributive Words.

He or *hetak* signifies "all" or "every one." These two words are much used, as *Ta ya he* (or, *hetak*) *qui vai vinak alabon ri xtani*, &c., Give bread to each one (or, to all) of the persons, boys or girls, &c. *Ta ya he* (or *hetak*) *qui vuh a***q***uala*, Give the letters to the boys, and to each one of them (the sense of the words being distributive).

vonohel, I all.	*konohel*, we all.
avonohel, thou all.	*yvonohel*, you all.
ronohel, that one all.	*conohel*, they all.

It may be remarked of this word that the first and second pronouns singular are not used, although they say: *Qui be vonohel* **q***uqin e val nu***q***ahol*, I shall go with all my people and sons. *Cat be avonohel* **q***uqin eaval ea***q***ahol*, Thou shalt go with all thy family. But it is chiefly used with the third person singular and the plurals.

¶. Note, that the third person singular forms the plural, when united to inanimate nouns as: *ronohel yxim*, all the maize; *ronohel abah*, all the stones; and we must not say, *conohel abah*. Further, this third pronoun singular, when added to collective names of plural signification, forms their plurals; as: *ronohel amaΣ*, all the town; *ronohel vinak*, all the people; *kobe ronohel*, we shall all go; *baix bey ronohel*, you shall all go; *que be ronohel*, they shall all go.

Compounds of *quis* or *qui*.

¶. *Naktux*, means who, which or what.
nakchique, which of them.
bilataon, something.
huhunal or *chuhunal*, to each one.

The numeral *hun*, one, is sometimes used for the indefinite article, and at other times as an indefinite pronoun; as, *hun chivichin xqui ya in*, one of you must give me; *hun vinak*, a man. Reduplicated it means each one, as *huhun chivichin xtiqamo hun che*, Each of you must bring a stick. For "somebody," the verb *qoh*, to be in a place, is used, as, *qoh xbano*, somebody did it, i. e.: "There was (who) did it."

The termination *ion*, means "alone," and is used with the possessive pronouns which precede consonants, it being a curious rule which holds good throughout this language that two initial vowels have the phonetic force of a consonant; thus:

nuion, I alone.	*kaion*, we alone.
aion, thou alone.	*yion*, you alone.
ruion, he alone.	*quiion*, they alone.

The negative "nobody" may be formed from *hun*, *manihun*, no one, as, *manihun tibe chi rochoch*, let no one go to his house.

Chapter III. Of the Verbs.

The verbs are rather difficult in this language on account of the variety of their compounds, and their number and diversity, because they have a particular verb for each specific act; thus, to eat, in its absolute sense is *qui va*, I eat, *cat va*, thou eatest, etc. For eating bread they say, *tin vaih;* for eating fruit or eggs, *tin lo;* for eating anything toasted, *tin aix;* for eating vegetables, *tin vechaah*. For this reason the whole difficulty in this language is in learning the verbs and their properties, and therefore something must be said about them, although it is a difficult topic.

There are two kinds of verbs; one kind governs cases and the other does not. All those which govern cases are held to be active, although in the Latin language they may be neuters, or deponents or common. Those which do not govern cases are neuter, and it is necessary to know this, because there are four classes of verbs, active, passive, neuter and absolute. The passive and the absolute are formed from the active verb, so that the active being known, the passive and the absolute can be formed, because, as I say, these are formed from the active

Sum, es, fui.

In this language there is no proper word to express this verb, and those who up to this time have employed a definite

word have taken that which corresponds to *sto, stare*, or to *habeo, habere;* for the word **q***oh*, does not mean "to be" (Spanish, *ser*), but "to be in a place" (Spanish, *estar*). To translate this sentence, "I am good," we may not say, *yn* **q***oh utz.* To express all that we say by the verb *sum, es, fui*, the Indians make use of the following method: They take the primitive pronouns in the appropriate person and number, and place them before any adjective or substantive noun, and thus form the verb; and by various additions and circumlocutions, they express themselves as freely and with as many moods and tenses as we do.

The above statement about the verb "to be" agrees with that in the grammar of Villacañas, but is attacked by Torresano. He writes, "Although other grammarians who have written of this idiom have stated that it does not possess the verb *sum, es, fui*, the contrary is clear enough. In certain tenses the primitive pronouns can be used with the verb *ux*, which, although usually conjugated with the pronouns of the passive voice, may also be conjugated with those of the active, and in that case it has the proper sense of *sum*."

Father Coto, who has a long note, covering several folio pages, on the rendering of the Spanish verb *ser*, cannot be said to endorse the above. He observes, "This verb *ux* seems to me to correspond in some way to the Latin *fio, fis*." The word to express the *essentia*, or natural character of a thing, he gives as **q***ohlem*, which is generally strengthened by the affirmative particle *xax* and the correlative *vi*, as *xax* **q***ohlem abah vi*, it is, in its nature, a stone; but it may also mean custom, habit. This was the most appropriate word found in Cakchiquel to express the being of God. The declaration of the persons of the Trinity runs thus: *Quereqa xax oxivi ru vinakil, xaqa hun qui* **q***ohlem, hun navipe Diosil, chi xax huna Dios vi chupam ru* **q***ohlem*, Truly three are the persons, one, the Being (of God), and one, God, and one, God in His Being. This highly abstract expression shows the capacity of the tongue for recondite thought: certainly it is not less clearly put in the Cakchiquel than in any European idiom.

Indicative Mood.

Present tense.

yn utz, I am good.	*oh utz*, we are good.
at utz, thou art good.	*yx utz*, you are good.
ha utz, he is good.	*he utz*, they are good.

This present is in very common use, and very properly takes

the place of I am, thou art, etc. In phrases of the third person, with a nominative expressed, the *ha* is dropped, as, *utz Pedro*, Pedro is good.

Imperfect preterit.

This tense is formed by adding to the primitive pronoun the particle *naek*.

yn naek utz, I was good. *oh naek utz*, we were good.
at naek utz, thou wast good. *yx naek utz*, you were good.
ha naek utz, he was good. *he naek utz*, they were good.

This is a circumlocution, and to complete its signification a word must be added, as in Latin when we say, *tu eras*—the phrase rests in suspense; hence we must say, *yn naek utz oher*, I was good in past time, thus conveying the sense of an action which was begun but not completed.

Perfect preterit.

The perfect preterit is formed from the present by suffixing a particle of past time, as *oher* or *xueri*, formerly; *yhir*,* yesterday; *cabihir*, day before yesterday, dropping the pronoun in the third person singular.

yn utz oher, I have been good. *oh utz oher*, we have been good.
at utz oher, thou hast been good. *yx utz oher*, you have been good.
ha utz oher, he has been good. *he utz oher*, they have been good.

Pluperfect.

To form this tense the letter *x* is prefixed to theprimitive pronouns and after them is placed the noun; except in the third person of the singular, where the pronoun is not used, but merely the *x*. This tense requires a sentence to follow it, for its explanation, and at its close is placed the particle *vi;* as: *xin utz vi mahaniok cat ul*, I had already been good before thou camest. But the *vi* may also be omitted, as, *xin ulinak*

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tok xat ul, I had already arrived when thou camest. Such a use of this tense is quite customary and elegant. Thus to speak of God as a great Lord before heaven or earth was made, we say, *Xaha vi xΣinom vi xtiqil vi Dios nimahauh mahaniok tu ban cah vleuh.* Such expressions are aided by a manner of speaking current among those Indians to express nature or habit in anything, although the time is not the same as in the tense we are discussing. Thus they say, *Xax ru çak vi ri ya çak ruach*, This water is by its nature white. *Xax ru qohlem vi ri Pedro nima eleΣom*, Pedro makes a habit of stealing.

Torresano gives several methods of forming the pluperfect, none precisely corresponding with the above. Thus:

hax in vi, I had been.	*hax oh vi*, we had been.
hax at vi, thou hadst been.	*hax ix vi*, you had been.
hax ha vi, he had been.	*hax he vi*, they had been.

Another is

yn ok, I had been.	*oh ok*, we had been.
at ok, thou hadst been.	*yx ok*, you had been.
ha ok, he had been.	*he ok*, they had been.

As, You had been sick when I came, *Ix ok yavai tok xin ul.* It may also be formed by the particles *chi*, *ok*, as, *at fiscal chi ok toxibe*, thou hadst been fiscal when I went; or the particle *chic* may be added, as, *In xax vinak chic tok xat ul*, I had been well when thou camest.

Future Imperfect.

This future is formed from the present by adding the verb *quin ux*, to have become (*ser hecho*).

yn utz xquinux, I shall have become good.

at utz xcat ux, thou wilt have become good.

In the third person the particle *ha* is not used, but the phrase is expressed thus:

utz xtux Pedro, Pedro will be good, or will have become good.

This tense may also be formed by placing at the end an adverb of future time as,

yn utz chuak, I shall be good to-morrow.

Also the particle *chic*, more, may be placed before the said adverb, as:

yn utz chic chuak, I shall be more good to-morrow.

The original omits the future prefix *x* in this tense, but I presume this is a fault of the copyist, and I restore it, following Torresano. He adds this example of its employment: *Ix loΣ xquix ux chire Dios ve tiΣil iviì pan imac*, You will become the beloved of God, if you abstain from your sins.

Future Perfect.

This tense is formed from the pluperfect by dropping the *vi* and suffixing the adverbial particle *tok*, when, and then the verb; as:

xin utz tok cat ul, I shall have been good when thou wilt have come.

xat utz tok tul Padre, already thou wilt have been good when the Father comes.

For this tense Torresano simply postfixes the particle *chic*, as:
yn nimanel chic, I shall have been obedient.
at nimanel chic, thou shalt have been obedient, &c.
It is difficult to appreciate the precise value of *chic* as a temporal particle. The following examples of its use from the *Calepino* of Varea will illustrate its force: *At mama chic*, already thou art an old man; *xul chic* he had returned; *xcamiçan chic*, he returned again to killing, etc.

Imperative Mood.

The imperative is formed from the present of the indicative by adding the particle *ok* after the pronoun and before the adjective-noun; but in the third person singular the *ha* is not used, and the *ok* is placed after the adjective noun; as

at ok utz, be thou good.

utz ok Pedro, let Pedro be good.

Note that this form of expression is more appropriate where, for example, one asks for a stone and they bring him a stick, and he says, *Abah ok, maqui che*, A stone, I say, and not a stick. They make much use of this verb, *quin ux, cat ux, tux*, which is, in Latin, *fio, fis, fit*, as an imperative, giving it its pronouns and numbers, as,

quin ux, may I become.

cat ux, may thou become.

tux, may he become, and so the rest of the persons, repeating them after the imperative forms, as,

at ok utz cat ux, become thou good.

They also use this imperative thus:

utz ok, let it be well done.
hebelo ok, be it well done.

Also in commands, as *xan ok*, bring bricks, *abah ok*, bring stones.

Future perfect of future time.

This future is formed from the present of the imperative by the use of one of the following particles: *chiok*, **q***ate***q***a*, *chui*, *chuhach*, *chirih*, *chupantok*. Thus, to translate the following sentence, Be thou good, after thou shalt have been baptized, *At ok utz kahinak chiok, ru ya Dios pan avi.* Again: Thou shalt be baptized and afterwards thou wilt be made good, *Ti kahna ruya Dios pan avi* **q***ate***q***a at utz cat ux.*

Optative Mood.

Present tense.

This tense is formed from the present indicative by inserting the particle *tah* between the pronoun and the noun which follows it, except in the third person of the singular where the pronoun is dropped.

yn tah utz, would I were good!
at tah utz, would thou wert good!
utz tah Pedro, would Pedro were good!
And so on for the other persons.

Torresano observes that there is but one form in this tongue for the optative and subjunctive mood, and he gives the above and the following tenses as subjunctives. He translates the particle *tah* in this connection by *utinam*, but adds that it has other significations. *Si*, if, the subjunctive sign, is *ve* or *veta*, and it will be seen that by its use, and some changes in the particles, our author frames his subjunctive mood.

Imperfect preterit.

This tense may be formed by adding to the present of this mood the particle *tok* and adding what sentence we wish, as: *Yn tah utz tok xirah oqueçax chi ahauarem*, oh, would I had been good when they wished to make me cacique!

It will be noticed that the author directs this and the following tense to be formed alike. This is no doubt an error of the copyist. Torresano forms the imperfect preterit by adding *quin ux*, as, *yn tah naonel quin ux*, I should be understood; and the perfect preterit by repeating the primitive pronoun and adding the perfect particle *inak*:

yn tah mitih in ux inak, I should have been careful.

Preterit perfect.

This tense is formed from the present of this mood by adding the particle *tok*, and afterwards the sentence that we wish, as in the preterit imperfect. Example: *Yn tah utx tok xin ul vave*, oh, if I had been good when I came here!

Preterit pluperfect.

This tense is formed by the present by prefixing to the pronoun the letter *x*, and beginning the following sentence with *tok*, as *xin tah utz tok xul ru tzih Dios*, oh, if I had been good when the word of God came! *Xatah ahau tok xin ul vave*, oh, if thou hadst been ruler when I came here! *Xahau tah Pedro tok xibe*, oh! if Pedro had been ruler when I went away!

Torresano forms this tense by prefixing the particle *xatavi* (x + ha + tah + vi) to the pronoun.

xatavi xin nimanel, would I had been obedient!

Future.

This is formed from the present in the same manner, by adding some particle of future time, as *chic*, *chuak*.

Torresano prefixes *veta*, if, and adds *ux*, as:

veta in nimanel quin ux, if I shall be obedient.

Subjunctive Mood.

Present.

The present of this mood is formed from the present of the indicative by prefixing the particle *vetah*, as: *Vetah yn utzilah christiano qui be chi cah*, if I be a good Christian, I shall go to heaven. Note that a common use of this tense is in sentences like the following: If I were a sinner, I would say that I am·

but it is not true that which they charge me with, *Vetah yn ahmac xquichatah, xaka maqui quere xa tan tih atox chirih.*

Preterit perfect.

This tense may be consistently formed like that of the optative by dropping the *tah* and putting in its place *ve;* as: *Ve yn utz tok, qui cam mani tin xibih vi rumal Diablo,* If I should have been good, when I die I shall not fear about the Devil.

Preterit pluperfect.

This tense is like the optative, dropping the *tah* and putting in its place *ve* or *veixh*, as, *Vetah xax yn Ξinom vi chila Castilla, maqui tah xin ul vave,* If I had been rich there in Castile, I should not have come here. *Vetah xax at vi ahauh, maqui tah quere catzihon vi,* If thou hadst been ruler, thou wouldst not speak in this manner.

Future subjunctive.

This tense is formed from the present by adding some adverb of time or some verb referring to the future, as, *Vetah yn utz, quin ux xavi cat utzir vmal,* If I shall be good, let it make thee good.

Infinitive Mood.

This is formed by a circumlocution, taking the present of the optative and varying it with the verb *tivaho*, I wish, *tavaho*, thou wishest, etc. Thus, *yn tah utz tivaho*, I wish to be good, etc. The Indians also use many other methods of speaking in this mood, as

utz tah nuqux tivaho, I wish to have a good heart.

utz tah nuqohlem tivaho, I wish to have a good life.

utz tah qui qohe tivaho, I wish to be in peace.

quinutzir tah tivaho, I wish to be good.

tirah tah nuqux yn tah utz, I wish that my heart may be good.

yn tah hebel, to be handsome.

yn tah chaom, to be beautiful.

The preterit can use the adverb *oher* or the others already mentioned, as, *Tivaho tah nuqux yn tah utz oher*, I wish to have been good formerly or in past time.

Future.

This tense is formed by placing the verb *quin ux*, before the desiderative verb, as, *at tah utz cat ux, tavaho*, Thou hast a desire to be good. It may also be formed in other ways, as, *Tiaho tah nugux yntah utz, quinux*, My heart wishes me to be good; or, *Yn tah nuqohlem, tivaho; yntah utz huna caba, yntah utz chic tivaho.*

¶. *Note.* As there is no proper word for this verb in any of its moods, tenses or persons, but it must be expressed by circumlocutions, its translations are numerous; and this is not surprising; it is enough to say that although there is no proper word for it, every one of its forms found in the Latin can be rendered into this tongue.

The verb *cat ux*, in the second and third persons singular and plural, may be used to ask questions, like *sum, es, fui;* as: *Nak cat ux?* Who art thou? Answer, *Yn*, I. Asking again, *Nakchi at?* Who art *thou?* Answer, *Yn Pedro.* So in thep lural, *Nak qui xux?* Who are you? When, seeing a person, the question is asked, *Nak cat ux?* Who art thou? it is equivalent to *Nak atah chok chinamitl?* Of what clan or lineage art thou? To ask, What wood is this? we say, *Nak che el vi?* and to ask of what dignity or position is this man, we say, *Nak ri kalem ri vinak?*

After a similar attempt to render into Cakchiquel the Spanish verb *ser* in its different forms—an attempt which is evidently out of place, as it has no correspondent in the tongue—Torresano translates the conjugation of the Spanish *estar*, in which he succeeds better, as that is properly translated by the Cak, q*oh*. I will give the first persons of the tenses with their Spanish equivalents, the Spanish grammar being richer in flexions than the English.

Indicative Mood.

Present: *tan in* q*oh*, yo estoy.
Preterit Imperfect: *xtan in* q*oh*, yo estaba.
Preterit Imperfect Negative: *xtan in* q*ohmani*, yo no estaba.
Preterit Perfect: *xi* q*ohe*, yo estuve.

Preterit Pluperfect: *yn ok qohevinak chic*, yo habia estado.
Future Imperfect: *xqui qohe*, yo estaré.
Future Perfect: *yn qoh chic*, yo habré estado.

Imperative Mood.

cat qohe, está tu.

Optative and Subjunctive Mood.

Present, *qui qohe tah*, yo esté.
or, *ve qui qohe.*
Preterit Imperfect, *xqui qohetah*, yo estaria.
Preterit Pluperfect, *xiqohe tah*, yo hubiese estado.
or, *veta xiqohe*, si yo hubiese estado.
or, *veta in qohevinak.*
Future, *veta xqui qohe*, si yo estuviera estado.

Infinitive Mood.

Present, *tan tivah qui qohe*, yo quiero estar.
Preterit Perfect, *xivao xi qohe*, quisé estar.
Future, *xtivaho qui qohe*, querré estar.

Gerunds.

Genitive, *qui qohebic*, para que yo esté.
Dative, *hata qui qohevi*, para que yo esté.

Participles.

Present, *qoh*, el que está.
Future, *qohlel*, el que ha de estar.

As I have already stated in the Introduction, this arrangement, on the plan of the Latin grammar, is forced, and violates the spirit of the Cakchiquel, as it would of all other American tongues.

On the Conjugation of the Verbs.

Active Verbs.

As has been already said there are four kinds of verbs in this language, active, passive, absolute and neuter.

The verb never varies its termination in any mood or tense. The mood and tense are distinguished by certain particles which in some tenses are placed at the beginning, in others at the beginning and end of the verb.

Active verbs are of two kinds, those which begin with a consonant, and those which begin with a vowel; and each of these has its appropriate particles to distinguish the number, person and tense.

The particles of active verbs, both of one or more syllables, which begin with a consonant are:

tin or tinu, I.	*tika*, we.
ta, thou.	*ti*, you.
tu, that one.	*tiqui*, they.

The form *tinu* for the first person is rarely used in the present, but more frequently in the future.

Present tense.

ti ban, I do.	*tika ban*, we do.
ta ban, thou dost.	*ti ban*, you do.
tu ban, he does.	*tiqui ban*, they do.

All the verbs of this class, of one or several syllables, are conjugated in like manner; as, of one syllable:

tin ya, I give.	*tin quir*, I untie.
tin q*'et*, I see.	*tin too*, I aid.
tin q*am*, I seize.	*tin toh*, I pay.
tin tak, I send.	*tin Σat*, I cut.
tin yak, I lift.	*tin* q*at*, I burn.
tin piz, I wrap.	
tin tiz, I spill.	

Of several syllables; as:

tin loΣoh, I love.	*tin* q*utuh*, I ask.
tin bijh, I say.	*tin chahih*, I keep.
tin rapah, I whip.	*tin* q*apih*, I shut.
tin tihoh, I teach.	*tin chomiricah*, I direct.
tin qahicah, I flog.	

And many others of one or more syllables.

Preterit.

The particles for the preterit of both these classes of verbs are,

xin or *xinu*, I.	*xka*, we.
xa, thou	*xi*, you.
xa, that one.	*xqui*, they.

The forms *xin* or *xinu* are used indifferently by the natives,

Perfect preterit.

xin ban, I have done.
xa ban, thou hast done.
xu ban, that one has done.
xka ban, we have done.
xi ban, you have done.
xqui ban, they have done.

And so of all the above verbs of one or many syllables.

xin ya, I have given.
xin **q**,*et*, I have seen.
xin **q***am*, I have seized.
xin tak, I have sent.
xin yak, I have lifted.
xin piz, I have wrapped.
xin tiz, I have spilled.
xin quir, I have untied.
xin too, I have aided.
xin **q**,*at*, I have burned.

And also,

xin loΣoh, I have loved.
xin bijh, I have said.
xin rapah, I have whipped.
xin tihoh, I have taught.
xin **q***ahiçah*, I have flogged.
xin **q***utuh*, I have asked.
xin chahih, I have kept.
xin **q**,*apih*, I have shut.
xin chomiricah, I have directed.

Pluperfect.

To form the pluperfect the particle *inak* is suffixed to the perfect as,

xin ban inak, I had done.
xta ban inak, thou hadst done.
xu ban inak, that one had done.
xka ban inak, we had done.
xi ban inak, you had done.
xqui ban inak, they had done.

Future imperfect.

To form the future imperfect, the particle *x* is prefixed to the present tense.

xti ban, I shall do.
xta ban, thou wilt do.
xtu ban, he will do,
xtika ban, we shall do.
xti ban, you will do.
xtiqui ban, they will do.

And so all these verbs, whether of one or more syllables, *xtin ya*, I shall give, *xtin* **q**,*et*, I shall see, *xtin loΣoh*, I shal, love, etc.

Future perfect.

This tense is formed by prefixing the following particles, *nu*, *a*, *ru*, and suffixing the adverb *chic*.

nu ban chic, I shall have done. *ka ban chic*, we shall have done.

a ban chic, thou wilt have done. *y ban chic*, you will have done.

ru ban chic, he will have done. *qui ban chic*, they will have done.

This future is also formed with the particles, *v*, *av*, *rr*, as,

*va***q***axah chic*, I shall have heard.
*ava***q***axah chic*, thou wilt have heard.
*ra***q***axah chic*, he will have heard.
*ka***q***axah chic*, we shall have heard.
*yva***q***axah chic*, you will have heard.
*qui a***q***axah chic*, they will have heard.

Another future is formed by the particles of the present and the suffix *na*.

xin loΣoh na, I shall have loved.
xa loΣoh na, thou wilt have loved.
xu loΣoh na, he will have loved.
xka loΣoh na, we shall have loved.
xi loΣoh na, you will have loved.
xqui loΣoh na, they will have loved.

These tenses are conjugated both with the primitive and derivative pronouns; as,

yn loΣon inak, I had loved.
at loΣon inak, thou hadst loved.
ha loΣon inak, he had loved.
oh loΣon inak, we had loved.
yx loΣon inak, you had loved.
he loΣon inak, they had loved.*

* Either an error of the copyist for *yn loΣoh inak*, etc., or an euphonic change.

And so, *yn ban inak*, I had done.
yn rapan inak, I had whipped, etc.

¶. The particle *tan* prefixed to the present of all verbs, active, passive, neuter or absolute, carries the notion of present action of the verb, as,

tan ti ban, I am doing.
tan ta ban, thou art doing.
tan tu ban, he is doing.
tan tika ban, we are doing.
tan ti ban, you are doing.
tan tiqui ban, they are doing.

And so,

tan ti bijh, I am saying.
tan tin ya, I am giving.
tan tin loΣoh Dios, I am loving God.

¶. Particles for active verbs which begin with a vowel. These are for the present tense, *tiv*, *tau*, *tir*, *tik*, *tiu*, *tic*.

tivaho, I wish. *tikaho*, we wish.
tavaho, thou wishest. *tiuaho*, you wish.
tiraho, he wishes. *ticaho*, they wish.

And so,

tivetamah, I know (*cognosco*).
tivoquiçah, I obey.
tivuqaah, I carry.
tivaqaxah, I hear.
tivulicah, I cause to come.
tivutziricah, I bless.
tivatiniçah, I cause to bathe.
tiveleçah, I take out.

¶. The particles for the preterit of these verbs beginning with a vowel are: *xiu* or *xu*, *xau*, *xr*, *xk*, *xiu*, *xc*; as,

xivaho, I wished, or, have wished.
xauho, thou " "
xraho, he " "
xkaho, we " "
xivaho, you " "
xcaho, they " "

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So also,

xivetamah, I knew, or, have known.
xiuaqaxah, I heard, or have heard.
xiuuqaah, I carried, or, have carried.

The pluperfect is formed from the perfect by adding the particle *inak:*

xiu aqaxah inak, I had heard.
xau aqaxah inak, thou "
xr aqaxah inak, he "
xka aqaxah inak, we "
xiu aqaxah inak, you "
xca aqaxah inak, they "

¶. The following particles are used with neuter, absolute and passive verbs, which begin with a vowel, *quin*, *cat*, *t*, *koh*, *quix*, *que:*

quin ul, I come.
cat ul, thou comest.
tul, he comes.
koh ul, we come.
quix ul, you come.
que ul, they come.

Again,

quin uquia, I drink.
cat uquia, thou drinkest.
tuquia, he drinks.
koh uquia, we drink.
quix uquia, you drink.
que uquia, they drink.

And so,

quinuxlan, I rest.
quinoc, I enter.
quinel, I go out.
quinoΣ, I weep.
quinoΣeh, I weep for something.

The particles which are used for the preterits of these verbs are, *xin*, *xat*, *x*, *xoh*, *xix*, *xe;* as:

xinul, I came, or, have come.
xatul, thou, " "
xul, he, " "
xohul, we came. or, have come.
xixul, you, " "
xeul, they, " "

And so,

xinuquia, I drank.
xinuxlan, I rested.
xinoc, I entered.
xinel, I went out.
xinoΣ, I wept.
xinnoΣeh, I wept for something.

The pluperfect is formed by adding the particle *inak* to the perfect; as,

xinul inak, I had come.	*xohul inak*, we had come.
xatul inak, thou "	*xixul inak*, you "
xul inak, he "	*xeul inak*, they "

¶. The following are the particles used with passive, neuter, and absolute verbs which begin with a consonant: *qui*, *cat*, *ti*, *koh*, *quix*, *que*, as,

quipe, I come.	*kohpe*, we come.
catpe, thou comest.	*quixpe*, you come.
tipe, he comes.	*quepe*, they come.

Again,

qui be, I go.	*koh be*, we go.
cat be, thou goest.	*quix be*, you go.
ti be, he goes.	*que be*, they go.

Another,

qui va, I eat.	*koh va*, we eat.
cat va, thou eatest.	*quix va*, you eat.
ti va, he eats.	*que va*, they eat.

Again,

qui var, I sleep.	*koh var*, we sleep.
cat var, thou sleepest.	*quix var*, you sleep.
ti var, he sleeps.	*que var*, they sleep.

And others, such as,

quixuque, I kneel.
qui biçon, I am sad.
quiqaze, I live.

The particles for the preterit are: *xi*, *xat*, *x*, *xoh*, *xix*, *xe*.

xipe, I came or have come.	*xohpe*, we came or have come.
xatpe, thou "	*xixpe*, you "
xpe, he "	*xepe*, they "

And

xibe, I went or have gone.	*xohbe*, we went or have gone.
xatbe, thou " "	*xixbe*, you " "
xbe, he " "	*xebe*, they " "

And

xiva, I ate, or have eaten.		*xohva*, we ate or have eaten.	
xatva, thou	"	*xixva*, you	"
xva, he	"	*xeva*, they	"

So also,

xivar, I slept, or have slept.
xixuque, I kneeled, or have kneeled.

The verb *vah* is a neuter and means "to wish."

quivah, I wish.	*kohvah*, we wish.
catvah, thou wishest.	*quixvah*, you wish.
tivah, he wishes.	*quevah*, they wish.

Thus,

quiquicot, I rejoice.	*kohquicot*, we rejoice.
catquicot, thou rejoicest.	*quixquicot*, you rejoice.
tiquicot, he rejoices.	*que quicot*, they rejoice.

The verb **q***oh*, to be in a place (Span. *estar*).

yn **q***oh*, I am.	*oh* **q***oh*, we are.
at **q***oh*, thou art.	*yx***q***oh*, you are.
ha **q***oh*, he is.	*he* **q***oh*, they are.

The following convenient presentation of the verbal particles is taken from Torresano's Grammar:

Verbal Particles.

1. For active verbs which begin with a consonant:

For the Present Imperfect and Future.

1. *tin*			*tika*	
2. *ta*	*loΣoh.*		*ti*	*loΣoh.*
3. *tu*			*tiqui*	

The particles are used in the Present with the prefix *tan*: in the Future with the prefix *x*, and in the Imperfect by prefixing *x* to the Present, as *tan tin loΣoh*, I love; *x tin loΣoh*, I shall love; *x tan tin loΣoh*, I was loving.

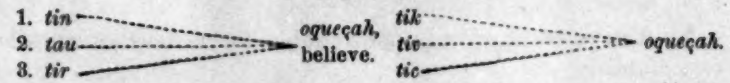
For the Perfect.

1. *xin*			*xka*	
2. *xa*	*loΣoh.*		*xi*	*loΣoh.*
3. *xu*			*xqui*	

The particle *mi* is prefixed to these when the action is recent; *xin loΣoh*, I have loved; *mi xin loΣoh*, I have recently loved.

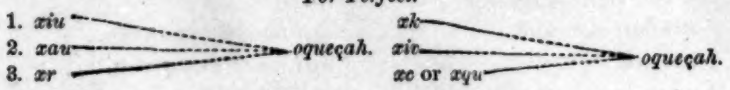
2. For active verbs which begin with a vowel:

For Present, Imperfect and Future.



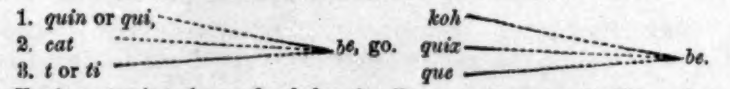
The same prefixes are used, *tan tin oqueçah*, I believe; *xtan tin oqueçah*, I was believing; *xtin oqueçah*, I shall believe.

For Perfect.



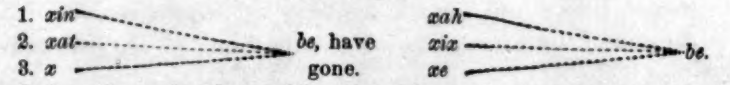
3. Particles for absolute, passive and neuter verbs.

For Present, Imperfect and Future.



To these *tan* is to be prefixed for the Present, *xtan* for the Imperfect, and *x* for the Future.

For Perfect.



As in active verbs, the particle *mi* may be prefixed to these to denote recent past time (the Preterit Proximate).

¶. The rules for the formation of absolute and passive verbs from active verbs of several syllables are as follows: The verb, *loΣoh*, for instance, drops the final *h* and takes in place of it *n*, and thus forms the absolute verb. This form may be used without an object, as *qui loΣon*, I love, not saying whom. But when the pronouns *yn*, *at*, etc., are prefixed, it has the force of the active, as *yn loΣon Dios*, I love God; *yn quirrapan alabon*, I whip the boys. This is the general rule for all active verbs of several syllables.

¶. Passive verbs are formed from active verbs of more than one syllable by dropping the *h* and substituting *x*, as *qui loΣox*, I am loved. After this form the ablative of the person must be used, as, *qui loΣox rumal Dios*, I am loved by God; *qui rapax rumal vahtih*, I am whipped by my master. This is

also the formation of the passive in verbs of several syllables which begin with a vowel, as *quina**q**axan*, I hear, *quina**q**axax*, I am heard.

¶. Active verbs of only one syllable form their passives in two manners.

The first is to drop the particles of active verbs, which are, *tin*, *ta*, *tu*, etc., and substitute those of neuter verbs which are, *qui*, *cat*, *ti*, etc., as,

tin ban, I make.	*qui ban*, I am made.
tin ya, I give.	*qui ya*, I am given.

And so with all verbs of one syllable.

The second form of the passive is by adding the particle *tah* to the verb preceded by a vowel like that in the verb, as, *banatah*, *yatah*, etc.

The Imperative.

All verbs of one syllable or vowel if it is *a*, *e*, or *i*, form their imperative in *a* in both singular and plural, e. g.,

tiban, I do; imper. *tabana*, do thou; pl. *tibana*, do you.

*tin**q**,et*, I see; imp. *ta**q**,eta*, see thou; pl. *ti**q**,eta*, see ye.

tin quir, I untie: imp. *taquira*, untie thou; pl. *tiquira*, untie ye.

tin piz, I wrap; imp. *tapiza*, wrap thou; pl. *tipiza*, wrap ye.

Those of one syllable with the vowel *o* form their imperative in *o*, as,

tin bot, I wrap up; imp. *taboto*, wrap thou up; pl. *tiboto*, wrap ye up.

tin cot, I scrape; imp. *tacoto*, scrape thou; pl. *ticoto*, scrape ye.

tin loΣ, I buy; imp. *taloΣo*, buy thou; pl. *tiloΣo*, buy ye.

Those of one syllable with the vowel *u* form their imperative in *u;* as:

*tin**q**ut*, I appear: imp. *ta**q**utu*, appear thou: pl. *ti**q**utu*, appear ye.

tinchup, I quench; imp. *tachupu*, quench thou; pl. *tichupu*, quench ye.

But if the verb is of more than one syllable, the imperative has the same form as the indicative, and one of these particles,

is added: *tah*, *taoc*, or *oc;* and these particles can follow all verbs, active, passive, neuter and absolute. In this case no vowel is added to the verb. For example, *taban tah*, *taban taoc*, *taba noc*, do thou. This form is deprecative, rather asking than commanding.

The pronouns *ru*, first person singular, and *ka*, first person plural, are often used with active verbs instead of these particles. For example: *Nuq,eta na missa*, q*ateq*a *quibe*, Let me first see the mass, and then I shall go. *Ka Σihala na xoΣohauh Sancta Maria*, q*ateq*a *tin bijh ru* q*ohlem sancto*, Let us first salute the queen, Holy Mary, and then we shall speak of the saint.

Another imperative and prohibitive is formed by dropping the first letter of any one of the above mentioned particles, and substituting the letter *b* or *m;* as, *baban*, do it not; *machup*, do not quench it. In this case no vowel is added to active verbs of one syllable, but the simple form of the verb is used, whether it be active, passive, neuter or absolute.

Optative Mood.

The particles of the optative mood are the same as those of the indicative, with the addition of the particle *tah;* as: *tin loΣotah*, would I loved God! *xiɸ loΣotah*, would I had loved God!

The particle *tah* is also placed after the particle of present time *tan*, and before the verb; as, *tan tah tinu* q*,et nu tata*, would I could see my father now!

Subjunctive Mood.

The particle *vetah* is used for this mood; as, *vetah tin loΣoh Dios*, *qui loΣox rumal Dios*, If I loved God I should be loved by God.

Infinitive Mood.

This is formed in a variety of ways.

The first is by taking the verb *tirah*, he wishes, preterit *xrah*, in the third person, without variation, and for the subject the pronouns *nu*, *a*, *ru*, or, if the verb begins with a vowel, *v*, *au*, *r;* and then the active verb, and not a passive or neuter; as, *tirah nu loΣoh Dios*, I wish to love God.

But if the sentence includes any of those accusatives above mentioned, to wit, *quin*, *cat*, *koh*, *quix*, *que*, the infinitive is formed by placing first this accusative, next, the verb *rah* without any particle, then the pronouns *nu*, *a*, *ru*, or, if the verb begins with a vowel, *v*, *au*, *r*, and lastly the active verb; as, *cat rah nu loΣoh*, I wish to love thee.

¶. Note that if the verb *tirah*, *rah*, is followed by a passive, neuter or absolute verb, then this verb *tirah*, is to be conjugated with the particles of the neuter verb; as

qui rah, I wish.
cat rah, thou wishest.
ti rah, he wishes.
koh rah, we wish.
quix rah, you wish.
que rah, they wish.

It agrees in number and person with the person who acts, and is followed by the passive, neuter or absolute verb without a particle; as,

qui rah var, I wish to sleep.
cat rah var, thou wishest to sleep.
ti rah var, he wishes to sleep.
koh rah var, we wish to sleep.
quix rah var, you wish to sleep.
que rah var, they wish to sleep.

Another method of forming the infinitive is by taking the verb *tivaho*, I wish, and then placing the active, passive or absolute verb with its pronoun in number and person, as,

tivaho tin loΣoh Dios, I wish to love God.
tavaho ta loΣoh Dios, thou wishest to love God.
tivaho qui var, I wish to sleep.
tavaho cat var, thou wishest to sleep.
tiraho ti var, he wishes to sleep.
tikaho koh var, we wish to sleep.
tivaho quix var, you wish to sleep.
ticaho que var, they wish to sleep.
tivaho qui loΣox, I wish to be loved.
tavaho cat loΣox, thou wishest to be loved.
tivaho quitihon, I wish to teach.
tavaho catihon, thou wishest to teach, etc.

Of the Gerund with the Accusative, and the First Supine.

To form a sentence containing a gerund with accusative, they make use, for the present and future tenses of the verb *tibe*, and for the preterit of *xbe*, both from *be*, to go.

They also use for present and future the verb *tul*, preterit *xul*, to come.

Both are used in the third person, and are not conjugated, but are followed by *nu*, *a*, *ru*, or, *v*, *au*, *r*, of the subject, the latter when the active verb begins with a vowel, and this active agrees in number and person with the subject. Examples: *tibe nu loΣoh Dios*, I am going to love God; *tul nu rapah ala*, I come from (I have just been) whipping this boy.

¶. Note, that if either of these verbs signifying movement, which are used in forming gerunds, *tibe*, *xbe*, *tul*, *xul*, is followed by a neuter, passive or absolute verb, then the verb of movement is conjugated with the proper particles of a neuter verb, and agrees with them in number and person, and the neuter, passive or absolute verb follows without variation. Examples,

qui be var, I am going to sleep. *koh be var*, we are going to sleep.

cat be var, thou art going to sleep. *quix be var*, you are going to sleep.

ti be var, he is going to sleep. *que be var*, they are going to sleep.

quin ul tihox, I am going to be taught.
catul tihox, thou art "
tul tihox, he is "
kohul tihox, we are "
quixul tihox, you are "
que ul tihox, they are "

quibe va, I am going to eat. *kohbe va*, we are going to eat.
catbe va, thou art " *quixbe va*, you "
tibe va, he is " *quebe va*, they "

xinul xuque, I come from kneeling down.
xatul xuque, thou comest "
xul xuque, he comes from "

xohul xuque, we come kneeling down.
xixul xuque, you "
xeul xuque, they "

Example: *Quibe tihon chuitak amaΣ*, I am going to teach in all the villages.

¶. Note that if a sentence with a gerund contains one of these accusatives, *quin*, *cat*, *ti*, the accusative is placed first, then the verb *be*, or *ul*, without a particle; next, the pronoun *nu*, *a*, *ru*, for the subject; and last the active verb, without a particle; as:

Quixbe nu loΣoh, I am going to love you.

Kohul iq,eta, you are coming to see us.

If with this accusative form it is desired to express a wish, as, I wish to go to see you, in this case the verb *tirah*, to wish, is inserted between the accusative and the verb of movement, as,

Quix rah be nuq,eta, I wish to go to see you.

Koh rah ul y camiçah, you wish to come to kill us.

¶. Note that when in a sentence like the above we place the subject first, or use the pronouns *nak*, who, or, *ha*, he, then the arrangement is, first the subject, next the verb *be* or *ul*, and lastly the absolute verb, not the active, and the pronouns *nu*, *a*, *ru*, are omitted; as,

Ahq,hamix xibe qamo chi vochoch, the Alguacil was going to my house to take me.

Nak xat rapan? Who whipped thee? *Ha xin rapan*, That one whipped me.

In such sentences the absolute formof the verb isu sed.

¶. Observe further that when we speak in the imperative, using a gerundive sentence, as, Go call the fiscal, or, Go and bring bread; such sentences are not formed with the verb *tibe*, but with the verb *hat*, go thou, or, *hi*, go you, a syncopated form from the same verb, the *x* being dropped; this is followed by one of the pronouns, *nu*, *a*, *ru*, for the subject and then the active verb; as,

Ha taka fiscal, Go thou and call the fiscal.

Hi qamar vai, Go you and bring bread.

Ha veleçah manteles, Go thou and take the mantles.

Chapter IV. On the Formation of Participles and Verbal Nouns.

There are participles and verbal nouns derived from active, passive, neuter and absolute verbs.

Verbal Nouns from Active and Absolute Verbs.

Verbals with the prefix ah. These verbal nouns are formed from active verbs by prefixing *ah* to the root; as *loΣoh*, to love, *loΣ*, a thing loved, *ahloΣ*, he who loves, or, in whom love is; *tih*, teaching, *ahtih*, the teacher. These are declined by means of the primitive pronouns, as,

yn ahtih, I am a teacher.	*oh ahtih*, we are teachers.
at ahtih, thou art a teacher.	*yx ahtih*, you are teachers.
ha ahtih, he is a teacher.	*he ahtih*, they are teachers.

yn ahloΣoh, I am a lover, or have love. (*sic.*)
at ahloΣoh, thou art "
ha ahloΣoh, he is "
oh ahloΣoh, we are lovers, "
yx ahloΣoh, you "
he ahloΣoh, they "

These do not govern any case after them.

This particle *ah*, prefixed to nouns signifies, native country, nation or business; as q*hamiy*, the staff of office; *ah*q*hamiy*, the person who carries it, the Alguacil; *ahpanΣan*, a resident of Guatemala.

Verbals ending in y. *LoΣoy*, he who loves. This termination corresponds to the *-tor* or *-trix* of the Latin, *amator*, *amatrix*. It is suffixed to active verbs of more than one syllable, and if they terminate in *h*, this letter is dropped. A primitive pronoun is prefixed, and the verbal governs the genitive, which is placed after it, as,

yn loΣoy avichin, I am a lover of thee.
at loΣoy vichin, thou art a lover of me.
ha loΣoy kichin, he is a lover of us.
oh loΣoy quichin, we are lovers of them.
he loΣoy yvichin, they are lovers of you.

Verbals ending in yom. *LoΣoyom*, he who loves; this participial is formed from an active verb of more than one syllable, the terminal *h* being dropped, and *yom* substituted, as, *loΣoh*, to love, *loΣoyom*, he who loves; *chahih*, to guard, *chahiyom*, he who guards; *etamah*, to know, *etamayom*, he who knows. *Dios etamayom ronohel ka banoh*, God knows (is the one who knows) all our works. In rare cases these verbals govern cases after them.

These participials can also be formed from absolute verbs derived from actives of but one syllable, as q,*et*, to see, q,*etoyom*, he who sees. The following sentence contains examples: *Mani* q,*etoyom*, *mani* aq*axayom*, *ri tuya Dios chiquichin eloΣoy richin*, literally, They are not seen, they are not heard, those things which God has to give to those (who are) lovers of him.

Verbals ending in el. *LoΣonel*, he who loves. This participial is formed from absolute verbs of more than one syllable by adding *el*, as, active, *loΣoh*, absolute, *loΣon*, *loΣonel*, he who loves; active, *rapah*, absolute, *rapan*, *rapanel*, he who whips. It is preceded by the primitive pronouns, and does not govern cases after it.

In some cases, but not in all, this participial may be formed from an absolute verb derived from an active of only one syllable; in which case the termination added is *nel;* as, *colo*, to set free, *colonel*, he who sets free; *tionel camiçanels* q*axtok*, a biter and a slayer is the Devil. These do not govern cases.

Verbals ending in inak. *LoΣoninak*, he who loved. This participial is formed from absolute verbs of more than one syllable by adding *inak*, as, *loΣon*, *loΣoninak*. From these participials is formed the pluperfect tense, as has already been stated. They are used like the last mentioned and do not govern cases, as, *yn loΣoninak*, I am he who loved.

Verbals ending in ic. This participial is formed from the absolute verb by adding *ic*, as, *loΣon*, *loΣonic*. It signifies the result of the action of the verb from which it is derived, as *loΣonic*, a work of love. They are not much used.

Verbals ending in em. This participial is in common use.

It is formed from absolute verbs by adding *em;* as, *loΣon*, *loΣonem*, that is a work of love. It is not united to pronouns, but is used absolutely, as *tan tiban loΣonem*, even now a work of love is performing; *tan tiban rapanem*, even now a work of whipping is performing; *tan tiban Σihalonem*, now a work of praying is performing, or, they are at prayer.

Verbals ending in bal. This is a verbal form in very frequent use; *loΣobal*, the love with which I love. It is formed from an active verb of one syllable by adding *bal*, as, *ban*, to do, *banbal*, that with which anything is done; and from those of more than one syllable by changing the terminal *h*, if there is one, into *bal*. It is conjugated by prefixing the pronouns *nu*, *a*, *ru*, and governs the genitive after it; as, *nu loΣobal avichin*, my love, or manifestation of love for thee; so, when an Indian brings a present, he says: *Nu loΣobal avichin vae*, This is the manifestation, or proof, of my love for thee.

Verbals ending in ol or ul. These are formed from active verbs of one syllable, as, *ban*, to do, *banol*, he who does; q,*et*, to see, q,*etol*, he who sees; if the vowel in the verb is *u*, the termination is *ul*, as, *cup*, to snatch, *cupul*, one who snatches. They are used with the primitive pronouns prefixed, and followed by the genitive, as, *yn* q,*etol avichin*, I am one who sees thee, that is, I come to see thee.

Verbals ending in oh or uh. These are formed from active verbs of one syllable. They signify the result of the action of the verb, as, *ban*, to do, *banoh*, that which is done, the work; *hox*, to fornicate; *hoxoh*, the deed of fornication; *loΣ*, to buy, *loΣoh*, the work of buying. They are used with the pronouns *nu*, *a*, *ru*, as, *nu banoh*, my work.

Verbal Nouns from Passive Verbs.

Verbals in el. These correspond to those in Latin in *dus;* they are formed from passive verbs by adding *el*, as, *loΣox*, to be loved, *loΣoxel*, that which is to be loved, Latin, *amandus*, *da*, *dum; ban*, to be done, *banel*, that which is to be done. They are conjugated by prefixing the primitive pronouns, and require the ablative after them, as, *ha banel vumal ri*, it is to

be done by me; *Dios loΣoxel vumal*, God is to be loved by me; *at loΣoxel rumal Dios*, thou art to be loved by God.

Verbals in inak. This is a past participle formed by adding *inak* to the passive verb, as, *loΣox*, to be loved, *loΣoxinak*, the having been loved. It is conjugated by prefixing the primitive pronoun and requires the ablative after it, as, *yn loΣoxinak avumal*, I have been loved by thee; *at rapaxinak rumal ahtih*, thou hast been whipped by the teacher.

Verbals in yc. These are formed by adding *yc* to the passive, and signify the passive action of the verb, as, *loΣox*, to be loved, *loΣoxyc*, the condition of being loved. They require the possessive pronouns to be prefixed, as, *nu loΣoxyc rumal Dios*, the love with which I am loved by God; *a loΣoxyc vumal*, the love with which thou art loved by me.

Verbals in om. These correspond to the Latin *tus*, *ta*, *tum*, and are formed from passive verbs of more than one syllable by changing the final *x* into *m*, and when the verb is of one syllable by adding *om*, or, if the vowel in the root is *u* or *a*, by adding *um* or *am;* as *loΣox*, *loΣom*, that which is loved; *banom*, that which is done; *chup*, to be quiet, *chupum*, that which is quieted. They are conjugated with the derivative pronouns, as *nu banom*, the thing that has been done by me; *nu* **q**,*etom*, that which has been seen by me; *nu loΣom*, that which has been loved (or bought) by me; *maihax*, to be held in reverence, *nu maiham*, that which is held in reverence by me. This participial is in very common use.

Verbal Nouns from Neuter Verbs.

The participials and verbal nouns formed from neuter verbs may be understood from the following examples:

Verbals in el. Oc, to enter, *oquel*, he who has to enter, as, *vae nu* **q***ahol oquel pa escuela*, this is my son who has to enter into the school.

Verbals in inak. Oquinak, the thing which has entered. These are conjugated with the primitive pronouns, as, *yn oquinak pa hay*, I am he who has entered into the house; *oquinak pe ha* that one has entered.

Verbals in ic. *Oquic*, the entrance. These are conjugated with the derivative pronouns, as, *voquic*, my entrance, *avaquic*, thy entrance.

Verbals in bal. *Oquibal*, the entrance; this word conveys all the meanings which I gave to the passive verbals in *bal*. These are used with the derivative pronouns, as, *mani voquibal aviqin*, I have no entrance with you, or, I have nothing to do with you; *mani roquibal nu vay;* I have nothing for its entrance (to enter with) my bread, that is, I have no meat to eat with it.

Verbals in em. *Oquem*, the entrance, signifies the action of the verb. It does not admit any pronoun before it, as, *xban oquem pa hay*, an entrance was effected into the house. To denote whose action it was, the genitive is used, and then the signification becomes of the present time, as *Oquem richin kahaual Jesu Christo pa templo tan qoh chi la Jerusalem*—Our Lord Jesus Christ, entering into the temple which is in Jerusalem.

Of certain Pronouns.

In sentences like some of the above, and like, "I love thee," "Thou lovest me," etc., there are five accusatives which serve for the presents and futures. They are:

quin, me.	*koh*, us.
cat, thee.	*quix*, you.
	que, them.*

The following are for past time:

xin, me.	*xoh*, us.
xat, thee.	*xix*, you.
	xe, them.

To form a sentence, we must first place the appropriate accusative as above, next, the derivative pronoun, *nu*, *a ru*, or, if the verb begins with a vowel, *v*, *au*, *r*, and then the active verb without a particle; as, *cat nu loΣoh*, thee I love; *qui nu loΣoh*, myself I love; *quix ka loΣoh*, you we love.

It will be noted that the *n* of the first person of the present accusative is dropped when the subject of the verb is of the

* In the future these are preceded by the future sign, *x*.

third person singular or plural, as *qui ruloΣoh Padre*, the father loves me; *qui loΣoh vtzilah vinak*, good men love me.

Observe that in these sentences the subject of the verb is placed at the end; and if we place it at the beginning of the sentence, as in using *nak*, who, or, *ha*, that one, then we must use the absolute and not the active form of the verb; as *nak xat bano?* Who made thee? *Dios xi bano*, God made me. *Nak xat vinakiriçan?* Who created thee? *Dios xi vinakiriçan*, God created me. *Pedro xoh camiçan*, Pedro killed us.

There are some reciprocal pronouns, which, although, they have already been spoken of, must be mentioned here. They are:

vi, myself.	*ki*, ourselves.
avi, thyself.	*yvi*, yourselves.
ri, himself.	*qui*, themselves.

They are placed after active and absolute verbs, as follows:

tin loΣoh vi, I love myself.
ta loΣoh avi, thou lovest thyself.
ti loΣoh ri, he loves himself, etc.

The same meaning may be expressed thus:

qui loΣon vi, I love myself.
cat loΣon avi, thou lovest thyself.
ti loΣon ri, he loves himself.

These accusatives may also be used with verbal nouns, as:

oh loΣon ki, we love one another.

And with passive participials in *on*, as,

nu loΣon vi, I love myself.
cat loΣon avi, thou lovest thyself.
ru camiçan ri, he is killing himself.

The particle *rijl*, placed at the end of verbals ending in *bal*, conveys the idea of universality, as, *loΣobalrijl*, the love which one has for all; *maihabalrijl*, the reverence which one has for all.

This explanation of what are called the "Transitions" is not very full, but contains the essentials. The other grammarians note some elliptical

forms. Thus with the negative adverbs *ba* and *ma*, there is a synthesis of pronoun and adverb, as:

bina (*ba* + *quin* + *a*) *camiçah*, thou dost not kill me.
bat (*ba* + *cat*) *nu camiçah*, I do not kill thee.
bohi (*ba* + *koh* + *i*) *camiçah*, you do not kill us.
be (*ba* + *que*) *a camiçah*, thou dost not kill them.

In the same way:

mina (*ma* + *quin* + *a*) *camiçah*, thou dost not kill me.

Chapter V. Of the Composition and Derivation of Verbs.

Verbs may be formed from almost all nouns, both substantive and adjective, by adding one of the following particles: *ar*, *er*, *ir*, *or*, *ur*, according to the usage of the Indians, as *mama*, an old man, *ti mamar*, to grow old; *utz*, a good thing, *tutzir*, to make oneself good; *teu*, something cold, *titeur*, to grow cold.

Active verbs may be formed from nearly all neuter verbs by adding the particle *içah* or *eçah*; as *tutzir*, to become good. *tutziriçah*, to make another good; *titeur*, to grow cold, *titeuriçah*, to make something cold.

The particle *beh* added to active verbs of one syllable, and to those of more than one syllable, dropping the terminal *h*, if they have one, forms an instrumental verb; as, *ban*, to do, *tibanbeh*, to do something with an instrument; *ti loΣbeh*, to show love with some act, as by giving a gift. *Tipe halal ya tin chahbeh nuΣa*, Bring a little water that I may wash my hands with it. *Ta ya hun tomin, tin loΣbeh nu vay*, Give me a tomin that I may buy my bread. A passive may be formed from this by changing the final *h* into *x*; as, *Vae hun abah ti camiçabex* q,*i*, Here is a stone, with which the dog may be killed. These instrumental verbs, whether active or passive, may govern genitives after them; as, *Vae hun colo taximbeh avikam*, Here is a cord for tying thy load; or, *Vae hun colo tixinbeh avikam*, Here is a cord with which thy load may be tied.

Neuter verbs may be treated in the same manner, though less frequently than actives, except that with them the form *ibeh* is employed. Actives and passives of these instrumental neuters are also used, as, neuter, *oc*, to enter, instrumental *oquibeh*, pas-

sive form, *oquibex*. Thus, *Xoquibeh Pedro avochoch*, Pedro entered thy house; *Xoquibex rumal Justicia avochoch*, Thy house was entered by the police.

Active verbs are formed from substantive nouns by adding one of these particles, *ah*, *eh*, *ih*, *oh*, *uh*; as *achbiil*, a companion, *tivachbilah*, to take one as a companion; *tzeb*, laughter, *tintzebeh*, to laugh at one.

Of Neuter Verbs, ending in e, of more than one Syllable.

There are in this language some neuter verbs, of more than one syllable, ending in *e*, as, *pae*, to stand up, q*uque*, to sit down, q*ule*, to marry, *hote*, to ascend. All these form active verbs by dropping the *e*, adding the initial vowel of the root, and suffixing the particle *ba*; thus, *pae* forms *paaba* to erect; q*uque* forms q*uquba*, to set down; q*ule*, q*uluba*, to give in marriage; *hote*, *hotoba*, to lift up. *Qui pae*, I stand up, *tin paaba*, I erect something; *qui* q*uque*, I sit down, *tin* q*uquba*, I set something down.

From these verbs ending in *e* certain participials are formed of frequent use, by changing the *e* into *l*; as *xuque* to kneel down, *xuqul*, he who is on his knees; *pae*, to stand up, *paal*, he who is on foot. The plural of these participials is formed by changing the final *l* into the initial consonant of the root and adding *oh* or *uh*; as *paal*, he who is on foot, *paapoh*, those who are on foot; *çaal*, clothing or anything else laid out to sun, *caacoh*, all the things laid out to sun. An exception is q*ulan*, married or united, plural q*uluquh*.

From this participial in *l*, are formed some active verbs with instrumental signification by adding *ibeh*. As this is a difficult point, it is best shown by examples. *Qui* q*otze*, to lie down; its participial is q*otzol*, he who is lying down; *tin* q*otzolibeh*, I lie down upon something. *Tipe hun varabal* q*ul*, *ruqin hun pop*, *tin* q*otzolibeh*, Bring me a sleeping dress, and a mat, so that I may lie down upon it. So, *qui* q*uke*, I sit down, *ti* q*ukulibeh*, I sit down upon something; *Dios nima ahauh*, *ru* q*ukulibeh xi tan* q*,hacat puakin*, God, the great Lord, is seated upon a seat of gold, or emeralds.

Of Frequentative Verbs.

These include frequentative verbs properly, and also distributive verbs.

Active verbs of more than one syllable, ending in *h*, change the *h* into *la*, as, *tin çipah*, I divide, *tin çiala*, I divide many times, or among many persons. Active verbs of only one syllable add the vowel of the root, and then the particle *la*, as, *tin chap*, I seize, *tin chapata*, I seize often or many things. There are not many frequentatives proper, with an active sense, in this language.

With regard to the passive verbs derived from these frequentatives, they are not formed as the other passives and absolutes above mentioned, but as follows: the *a* in which the frequentatives end is changed into *o*, and then the absolute is formed in *on*, and the passive in *ax;* as, *tin çipala*, I divide often, *qui çipalon*, I divide out, *qui çipalox*, I am divided out frequently.

Chapter VI. Of some Particles and Adverbs.

The particle *vi* is much used in this language, and for many purposes.

Whenever time or place is specified before the verb, the latter must be followed immediately by *vi;* as *chi rochoch Dios* q*o vi Padre*, In the house of God is the father. But if the verb is placed first, the *vi* is not used; as, q*oh chi rochoch Dios*, he is in the house of God (the church).

Again, in employing the dative, if it precedes the verb, the latter must be followed by *vi;* as, *chi richin Pedro taya vi*, to Pedro thou must give. But if the dative is placed after the verb, the *vi* is not used; as, *xnu ya chirichin Pedro*, I gave it to Pedro.

It has also the signification of the instrument, if it immediately follows the verb; as, *abah xin camiçah vi tziquin*, with a stone I killed the bird; but if the instrument is placed after the verb, *vi* is not used, but the particle *chi*, as, *xin camiçah tziquin chi abah*, I killed the bird with a stone.

Whenever the verb is preceded by the particle *ha*, the particle *vi* must follow; as, *Ha quix colotah vi*, With this you will ascend to heaven.

In other cases *vi* is used to convey affirmation, as, *Kitzih chi xaban vi mac*, Certainly you committed a sin.

The particle *ach* has no signification by itself; but joined to nouns it conveys the idea of participation in their signification, and it is used with the possessive pronouns; as, *ahmac*, sinner, *achahmac*, he who sins jointly with another; *vachahmac*, my accomplice in sin; *achbilatz*, he who goes with another; *vachbiil*, my traveling companion.

The particle *quereqa* is illative, and corresponds to *ergo* or *igitur*, therefore, then, for that reason. Whenever it precedes a verb in this sense, the latter must be followed by the particle *vi;* as *Quereqa ta loΣoh vi Dios*, Therefore love thou God.

¶. There are four very important verbs which are placed absolutely at the end of sentences containing a gerund with accusative. They are *el*, departing, *apon*, arriving, *kah*, descending, *pe*, coming; and this particle *Σaneh*, or *aΣaneh*, which means "upward."

The verb *el* is used by the Indians thus: *ta qama el ri plato*, Take out, departing, this plate; *ta tixa el ya qoh chupam xarro*, Pour forth, going out, the water which is in the pitcher. The Zutuhils are accustomed to add *o* when the sentence ends in *el*.

The verb *apon* means "arriving there," not "coming here." It is used as follows: *ta biih apon chire fiscal chuac quin apon chire*, say to the fiscal on arriving there (or, when thou arrivest there) that to-morrow I am going there. *Chuak tel apon nu camahel ruqin Padre*, To-morrow will go forth my messenger to the place where the Father is.

The verb *kah*, is used when one being in an elevated location speaks, or writes, or sends to one who is situated lower. Thus, when one is in Atitlan and speaks of the coast, he would use this *kah*, as, *tibe qamar kah q,ih taΣah*, they are going to carry flowers, descending (or down) to the coast.

The verb *pe*, to come, is used as follows: *ta tzih pe candela*,

light, coming, a candle (come and light a candle). Thus the preacher says to the people, that they be attentive during the sermon: *Ti ya pe yqux, ti ya pe yxiquin, tivaqaxah pe, vae loΣolah tzih xtin biih chivichin*, Give your hearts hither (coming hither), give your ears hither (where I am), listen (in this direction), they are precious words which I shall speak to you.

The particle *aΣaneh*, means upward, Latin, *sursum*, as, *qui muku aΣaneh*, I look upward.

The particle *can* means "remaining;" as, *xu biih can kahaual Jesu Christo*, the aforesaid our Lord Jesus Christ; *xi ru pixabah can nu tata tok xbe panΣan*, my father discharged me, I remaining behind, he going to Guatemala; *quere nu tzih, nu pixa, vae xtin ya can xtin qoh ba can*, These are my words, my commands, which I give to remain, as I shall go away. The expression *xambey can*, means, remain behind; *chuih can*, in my absence, after I had left.

The particle *na* has no signification when used alone; but when joined to other words it has various meanings. It is from *nabey*, first, or, the first. Thus it may mean "until," Latin, *donec*, as, *cat nu chubiçah na chicam tiqo na nuqux chavih qate ti tuker nuqux*, I shall punish thee and shall not be satisfied until I have visited on thee my anger. *Tul na Padre qateqa catbe*, Do not go until the father hears thee; *qahaok na Padre tibiin ru chohmil chuo qateqa tinu kiquih*, I shall not consider it true until the father tells me. *Nu qux na tahoon tinu ya chaue*, Until my heart desires it, I shall not give it thee. *Tin biih na ruchohmil Justicia*, In the first place I shall tell the truth to the magistrate; *qacamic na*, until death; *qe ta na*, presently, after a while. A boy about to be whipped will say, *humul chita na*, pardon me this time, wait until the next time.

The particle *bala* means "somewhere." *Ba qo vi Padre?* Where is the father? *Bala qo vi*, Somewhere, I don't know where. It also corresponds to all four of the adverbs of place, *ubi, unde, quo, qua*. *Ba xpe vi Padre?* Whence came the father? *Bala xpe vi*, I don't know whence he came. *Bi che el*, or, *nak che el?* How? In what manner?

Bilanak, "something," "anything." *Tok bilanak ti biin*

chaue ytzel tziih, *ma* **q***utuba*, When any one speaks evil words to you, do not answer him. *Mani bilinak xu biih Padre chue*, The father did not say anything to me.

Other particles: **q***abala*, from time to time; it may be used with repetition; **q***ahantak la nu nantil*, the same; **q***a ru naht*, the same; **q***o quipe*, **q***o* **q***a mani*, sometimes I go, sometimes not; *mani humul vakan chirochoch*, not one time have I put foot in his house; *vave*, here; *varal chire*, there or then; *chila*, over there, far; *halal*, a little; *halal chic tiraho tijh*; the food lacks a little, it is not ready, an Indian phrase; *halan-hal***q***at*, differently, pl., *halahoh qui* **q***ohlem ahaua*, the modes of life of the chiefs are different; *halahoh que tzihon*, they speak differently, some well, some ill; *xere*, only this; *hu***q***içic xa xere tin biih ri*, only this do I say to thee; *hu***q***içic* xtin ya chavichin re*, or *vae*, this only will I give to thee; *hiquil*, intimates a fixed purpose, as, *hiquil nube ic chuak*, My departure to-morrow is certain; *kitzih*, truly, certainly; *chi kitzih vi chi*, the same; *kitzih utz Dios*, truly God is good. The following are used with reference to past or future time in narration or reference, *haok*, *katok*, *tok;* but in asking about past time they say, *xhani***q***al?* How much time? And for future they say, *haruh*, when? *Haruh cat be?* When wilt thou go?

*The word *hu***q***içic* is a compound of the numeral one, *hun*, and the verbal q*içic*, from q*iz*, to finish, to end, hence, "that which ends in one," or is alone. (*Coto.*)

SUPPLEMENT.

The following additional material, necessary to a grammatical survey of the tongue, I have culled from the various MS. sources heretofore mentioned.

Comparison of Adjectives.

This is accomplished by the use of the particles *chic*, as, *nim chic halal*, a little larger, *ki*, and *atza*, as, *atza quixan pe*, come a little nearer; and by adding the past participles, *iqovinak* and *yalaquhinak*, which mean to pass beyond, to exceed, as, *iqovinak chi nim*, greater (it exceeds in greatness), *yalaquhinak chi utz*, better (it surpasses in goodness).

Interjections.

Ahkook! or *akookee!* Ah! Alas! Oh! Expressive of sadness or compassion. This is much used by the priests in their sermons.

Acay! When one is beaten or ill treated.

Aqe! When one is suffering pain, as, for example, when bitten by some animal. The correlative of this interjection in the particle *Σe*, which is placed at the end of the sentence, as, *Aqe, xqui cam Σe!* Alas! I shall die!

O, A, Ae, are exclamations of admiration as in the compounds, *A bin qa, O maihan re*, etc.

Aco! Oh! expressing a wish, as, *Aco mixat nuqul*, Oh! that thou hadst come!

Kitah, kitari, kitanari, kitanaqa, kitanaan, queretah, queretare; all these are desiderative or deprecatory. The root of the first five is the particle *ki* which is used to ask a question in a confident and friendly manner, hence *kitzih*, the truth.

Adverbs.

Affirmative Adverbs. *Kitzih*, truly; *kitzihan*, very truly; *xaiqa*, also; *qo, he, xaviutz*, it is well; *haquere*, be it so; *haqaquere*, in the same way.

Negative Adverbs. *Mani* or *maqui*, not; *xax mani vi*, by no means, not at all; *mahani*, not even; *maquiam queretah*, it is not so; *mahaniok*, is a negative indicating past time, as, *mahaniok tikaΣih tok mi xinol*, the sun had not yet set when I came. The particles *ba* and *ma* are used as negatives in the singular number, second and third persons, especially with imperatives, as, *ba ban ri*, do not thou do that; *ba malih aqux*, do not be faint-hearted. In the plural these words become *bi* and *mi*, as, *mi ban ri*, do not you do that; *bi pokonariçah ivii*, do not abuse one another. The form *maqui tanaan*, a compound of *maqui*, not, *tan*, particle of present time, and *an*, an emphatic particle, is a negative, corresponding to the affirmative *ki tanaan;* they have the meanings, "not now at any rate," and, "even now at any rate." The compound *mamanion*, is a negative interrogative, or alternative, as, *avetaam pe, mamanion?* Dost thou know

me, or not? *Avetaam pe nu* q*ohlem, mamanion?* Dost thou know me, or not? *Quere pe, mamanion?* Is this so, or not?

Interrogative Adverbs. The general interrogative is *nak?* What, or, What is this? Who? Which? *Nak qui xox vi?* Who art thou? *Nak la* q*a rumal?* For what reason? *Nak pe ri?* What is this? *Ba,* where? *Ba pe* q*o vi?* Where is he? *Balaqa* q*o vi ruchohmil?* Where is the truth of this? *Bi* and *be* also have interrogative force, as, *Be chok ia vetamah vi ri?* How didst thou know it? *Been xa ban?* How didst thou do it? *La kitzih,* truly? as, *La kitzih pe xabiih ri?* Truly, didst thou say this? The particle *maki* is in very common use for the affirmative interrogatives, well, well then, etc., as, *Maki tekumu halal ya?* Then, thou willst not drink water?

Dubitative Adverbs. The particle *la* expresses a doubt as to whether the action referred to has occrured; as in answer to the question, Has the father come? The reply, *Mi la xul,* or *Mi xul la,* means, He may have come, it is possible. A much used compound of similar signification is *pachΣom* q*a vach,* from *pachΣom,* to turn, to change; it is used with the possessive pronouns, as, *pachΣom ru vach nuqux,* I am in doubt, literally, my mind (*heart*) changes its face.

Numerals.

1—*hun.*	41—*hunroxqal.*
2—*cay.*	42—*cay roxqal,* &c.
3—*oxi.*	60—*oxqal.*
4—*cahi.*	61—*hun ru humuqh,* &c.
5—*voo.*	80—*humuqh.*
6—*vakaki.*	100—*oqal.*
7—*vuku.*	101—*hun ru vakqal.*
8—*vakxaki.*	120—*vakqal.*
9—*belehe.*	121—*hun ru vukqal.*
10—*lahuh.*	140—*vukqal.*
11—*hulahuh.*	160—*vakxak qal.*
12—*cablahuh.*	180—*belehqal.*
13—*oxlahuh.*	200—*otuc.*
14—*cahlahuh.*	300—*volahuhqal.*
15—*voolahuh.*	400—*omuqh.*
16—*vaklahuh.*	500—*omuqh oqal.*
17—*vuklahuh.*	600—*omuqh otuc.*
18—*vakxak lahuh.*	700—*omuqh volahuh qal.*
19—*beleh lahuh.*	800—*caΣo.*
20—*hu vinak.*	900—*oxqal roxoΣo.*
21—*hu vinak hun,* &c.	1000—*otuc roxoΣo.*
40—*ca vinak.*	8000—*hu chuvy.*

The numeral *voo,* five, when joined with the possessive pronoun loses its initial letter, as, *roo,* his five. Verbals are formed from these numbers, as from other radicals.

The ordinal numbers are formed from the cardinal by prefixing the possessive pronoun and dropping the final letter.

ruhu, first.	*roo*, fifth.
ruca, second.	*ruvakak*, sixth.
rox, third.	*ruvuk*, seventh.
rucah, fourth.	*ruvakxak*, eighth, etc.

The use of *numeral particles* is very frequent. I take the following list from Torresano's Grammar in the order he gives them.

pah, for counting words. With this particle the numerals lose their last vowel, and *vakaki* its last three letters, as, *kupah*, *capah*, *oxpah*, *vakpah*, &c.

rabah, for counting skeins, threads, or things sewed ; *hurabah*, *carabah*, etc.

Σa, for counting hands, and fives, *huΣa*, *caΣa*, *oxΣa*, etc.

q*ulah*, for counting pairs.

moΣ, for counting handfuls, or fists.

lep, for the same.

q'*uh*, for counting drops.

biΣ, for counting chips and crumbs.

lic, for counting spoonfuls.

yacah, for counting large things, as beams, logs, and weights.

remah, for counting provinces.

q*hob*, for counting districts.

q*olah*, for counting spherical things, such as eggs, balls, etc.

cholah or *ley*, for counting things arranged in order.

tzeah, or *chiah*, or *quiah*, for counting bundles of things tied together.

chacah, for counting bundles like those of sarsaparilla, tied together.

vi, for counting shoots and stems of trees, etc.

telah, for counting armfuls of wood or grass.

ram, for counting clubs or sticks.

molah, for enumerating the differences between things.

tuz, for counting high things, as the ceilings of rooms, or the upper rooms of a house.

rap, for counting strokes or blows.

perah, for counting paper, the leaves of a book, tortillas, or other thin articles which are laid one over the other.

buçah, for counting things that are doubled or folded, as pieces of cloth.

q'*iz*, for counting sewed sheets or other sewed articles.

hah, for counting armfuls of woods, sticks, etc.

yatah, for counting bundles or other tied articles.

Σeteh or *borah*, for counting small bundles of grass or wood which can be carried under the arm.

cep, for counting sites of villages.

bolah or *Σer*, for counting bundles of straw.

çutah, for counting pieces of sown land.

tzobah, for counting small patches of corn-land, of good soil.

qutu, for counting spans.
xaΣ, for counting paces.
le, for counting spaces between floors.
tanah, for counting degrees, chapters, sins, law-suits, etc.
Σala, for counting cacao grains, by scores.
vinak, for counting months according to the method of the Indians, from 20 to 20.
a, for counting years.
may, for counting years by twenties.
mul, for counting repetitions.
oc, for counting with exclusion, *hunoc*, one only, *cayoc*, two only, etc.
Σat, for counting long strips.
hal, for counting changes.
qhay, for counting businesses.

To these from Torresano may be added from other sources :
bic, for counting songs, words, or blows, as *hubic chibix*, one song.
lah, for counting 14 at a time.
patal, for counting loads, *hun patal aqam*, one load of salt, etc.

To express that a quantity is finite and can be counted, the word *choyol* is used ; to express that it is infinite or cannot be counted, they have the word *ramal ;* or the negatives *maqui choyol*, *maqui Σatal*, innumerable.

To express a half, the word *tanal* is placed before the numeral, which takes the possessive, as *tanal ru cay*, *tanal rox*, *tanal ru cah*, etc.

Particles.

In American tongues the study of the particles is preëminently required in order to gain an insight into the shades of meaning between similar expressions. To them also we must turn if we would trace these tongues to their primitive forms, and gain a clear conception of their organic peculiarities. By some writers these particles are considered worn down verbal or nominal roots, but I rather hold that this is the exception, and that most of them are true radical forms themselves, and must be ranged under a grammatical category foreign to any known to the Latin grammarians.

This question need not be discussed here, and it will be enough for practical purposes to arrange in alphabetical order the principal but by no means all the particles found in the Cakchiquel.

Aco. Expresses satisfaction, as if one had found that which he was searching for.
AΣaneh. Verbal particle, see p. 404.
An. Particle to say that it is well. *Utzan*, it is well.
Avah, or *Avahuh*. Generic part, applied to any animal, bird, or bee, such as builds itself a house.
Atza. Enough ; *atza qoh*, *taqa mape*, "trae bastante."
Ba. Imperative and prohibitive particle.
Benakil. Many times ; *benakil nu bijm chave*, I have often told you it.

Beh. Particle added to verbs to signify the instrument with which the action is accomplished.

Ben. Particle to express "since" or from a certain time; *xrulīben Pudre*, since the Father came; *xu ka hi bem* (*sic*) *ya panuvi manitan qui qule*, since I was baptized, I have not sinned.

Can. Particle signifying past time; *nu bīin can*, I have already said.

Cani or canih, soon; *canicabe vacami man chic catqohe vaue, ahora luego vete ya no estes aqui.*

Co. Particle to concede or grant something; *coco*, all right, very well, yes.

Cohol, between; *cohol hay*, between the houses.

Chic. See p. 376.

Ha, that one; also, it is, or, it is so; *ha ri*, it is thus; also in causal sense, *ha nim vi ri Sancto*, because the Saint is great; something great or strong, *ha Σih*, a hot sun, *ha hab*, a heavy rain.

Hak, to open out, or to separate things joined; *tahaka ru nakavach*, open your eyes; *hakal vuh*, the book is open; *ti haka yxiquin*, open your ears, *i. e.*, listen attentively.

Haz, to shut up, hence a secret, in secret; *hazha pa ru xiquin*, to tell in the ear.

Ho, interjection intimating going; *hoho*, come along, let us go hence; applied to the woman who offers herself to a man; *tu ho ri yxok*, the woman offers herself; of the day which goes quickly (as *holoho*); *xholo yan Σih*, the day is soon gone; *xholoho ranima*, his soul departed (he died); *hote*, to go upward, rise; *cat hote chirih queh*, get on your horse; *hotoba*, to lift, to raise up; *hotay*, the sprouts of trees which shoot up, also the descendants, offspring of a man; *enuhotay*, my descendants.

Yan, particle denoting brevity; *xatul yan*, you have just come; *xqo yan xinul*, I have already come. Thus this particle may mean both a short and a long time.

Yx, part. of past time.

Ychal, part. denoting plurality.

Yben, part. joined to names parts of the body to distinguish them, as *qalqaxibeni* (*sic*), *ri xa*, the water came to my knees.

Ka, part. of direction, downward; as verb, *ka*, to descend. *mix ka chi, xibalhay*, he descended into hell; to tear down a house; to set (of sun or moon); to diminish (of a boil); to descend in health, to grow sick, etc.

Ki. 1. An interrogative, putting a question in a friendly manner expecting a truthful reply. 2. In space, that which is locally nearest, as, *hakiha vochoch ri qo oc chachi bey*, my house is nearest the road.

La, particle to intimate that one has not seen what has taken place; expresses a doubt.

Ley, part. to denote that something is one of a class, *hu ley vinak*, a person of one, age, nation, dress, color, etc.

Na, first, in all senses. Hence, as a verbal, to be first, to await others;

nare, before me, thee; etc; *naek*, but, although (*i. e.*, = consider first); *navipe*, or *naype*, then, next, and.

Naht, far, deep; of time, long.

Noc, a word of disfavor, or disapproval; used, for instance, when one counts erroneously, or makes a mistake.

Paki, at once, immediately, *tin ban paki*, I do it at once.

Pum, or *Pu*, in, within; hence, the stomach, belly or bowels, as the "inwards" of old English writers.

Pe, toward this place, hither; as a verbal, to come hither.

Ta, a particle of courtesy used by and to married people; as, *Dios ca chahin ta*, God protect you; hence, *ta ta*, O lord!

Tah, particle to express like or desire, used in asking something which one is uncertain about receiving; as a noun, pleasure, satisfaction; as a verbal, to desire, to wish.

Tahin, particle of present time, as *tan pe que tahin yxoki chuque xic nu vay?* are the women now grinding my corn? Ans. *Tan que ta hin*, They are even now doing it. In the combination q*atahin*, it means "a little," a short time.

Tak, conveys the idea of repetition. With reference to events it signifies that they happen recurrently; added to numbers above five it means a division among many. Thus they say of intermittent fever, *hu tak petic rax tev chuvih*, I am suffering from recurrent chills. It is also used to form certain plurals which have an implied idea of recurrence, as, *ronohel tak mul*, all the time, every time.

Tan, part. of present time, see *tahin*, and page 385.

*To*Σ*e*, an exclamatory particle used to call a person who is near.

Va, a particle of assent, or of intimation that one is near what he is seeking.

Ve, primarily expresses a doubt, and from this a concession, hence is used to signify consent or yielding to a request; *ve ta*, be it so.

Vi, see page 403.

Xambey, after others; as, *xambey can*, he comes after, either in space or time.

Xe, below or beneath; *xe hoy*, beneath the house; *ru xe che*, the root of a tree.

q*a*, conveys the idea of a short distance either in space or time, as, q*a tan tul Pedro*, Peter came *a* short time ago; q*a aqual yq*, the new moon; q*a aqual Pedro*, Peter is young yet; q*a tan tahin missa*, they are still saying mass; q*a aqa hay*, a newly-built house.

On a Case of Human Congenital Malformation. By Harrison Allen, M.D.

(*Read before the American Philosophical Society, December 21, 1883.*)

I desire to place upon record the facts in the case of a man born with rudiments of the superior extremities. Similar cases, it is true, have been recorded, and in a sense, this history lacks the claim of a positive contribution to knowledge. But it is well to record each example of unusual conformation, when novel facts pertaining to the adult state, to habit and to acquired deformity, can be demonstrated.*

The case is one of a group denominated Perobrachia and is embraced in the following account:

John E. Casey, aged sixty-four years, one of a family of seven well-formed children of healthy parentage was examined Nov., 1883. The subject was four feet and seven inches in height. In the place of the left superior extremity a small pedunculated lobule one inch in length was suspended from the axilla a short distance behind the group of axillary hairs. This lobule retained a slender rod of bone which could easily be determined, and which doubtless was homologous with the bones of the normal left superior extremity.

The right superior extremity was a small unidigitate member, bent at the middle so as to resemble a letter L and when at rest so disposed to the trunk as to correspond in length to the side of the thorax.

The humerus was apparently dislocated upon the dorsum of the scapula on an outward extension of the glenoid cavity, and the bone was thus held in an exceptional relation to the scapula. The shaft of the humerus was bent at the distal third so as to present a convexity outward and yielded a short distance above the elbow to its lateral side, a small spine which while detected with ease, did not form an elevation of the skin.

The position of the olecranon and that of the elbow-joint could be readily determined. The remaining portion of the extremity represented elements in a single axis excepting at the terminal phalanx. Within this axis the bones of the forearm, of the metacarpus, and the two phalanges of one digit could be identified.

The bones of the left shoulder-girdle were small but complete.

Of the right elements it was found that those of the shoulder-girdle were unusually well developed. Both scapulas were elevated, and the clavicles obliquely placed, the sternal ends determining the lowest, and the eleva-

*A somewhat similar specimen to the one described is reported by Otto (Monstru. Tab. xvi, figs. 7, 8, p. 138). The condition was symmetrical, the radius absent, and the single finger was identified as the fifth, since the ulnar nerve passed to it. The subject was an unviable female fœtus, of the seventh month. Förster (Missbildungen) refers to several cases; references imperfect and not reliable. See also Anger (Nouveaux Elements de l'Anat. Chirurgicale, 573, 574).

tion of the scapulas (through the agency of the trapezii, rhomboidei and elevators of the angle of the scapula) the highest levels.

FIG. 1.

FIG. 1.—Front view of a case of Perobrachia, showing the rudiment of the left upper extremity, and the undigitable right upper extremity.

FIG. 2.

FIG. 2.—Back view of a case of Perobrachia, showing the rudiment of the left upper extremity, the disproportion between the scapulas, the deviation of the vertebral column, and the relaxation of the muscles of the buttock.

The *measurements* were as follows:

Left Side.

The length of the spine of scapula	5″.3‴
Greatest length of scapula	5″.6‴
Distance from angle to tip of acromion	6″.6‴
Length of clavicle	3″.6‴

Right Side.

The length of spine of scapula	5″.6‴
Greatest length of scapula	5″.6‴
Distance from angle to coracoid process	6″.9‴
Length of clavicle	6″.0‴
Length of humerus	10″.0‴
Distance from proximal border of exostosis to the elbow	4″.0‴
Distance from elbow-joint to wrist-joint	2″.0‴
Length of first phalanx	1″.6‴
Length of second phalanx	0″.9‴

The *motions* of the left extremity were confined to upward traction of the scapula as already mentioned, and backward traction of the lobule, the latter apparently through the agency of a pannicular muscular sheet.

The motions of the right extremity embraced the powerful effects of the tractors of the scapula, and the flexors and extensors of the forearm. The shoulder-joint being anchylosed, the extrinsic muscle of the shoulder-girdle, the trapezius, the serratus magnus, the levator anguli scapula, and the serratus magnus, and possibly the sub-clavius, were mainly effective in moving the extremity. The pectoralis major was also powerful. Abduction of the arm (probably rhomboidal) was associated with marked median (*i. e.* vertebral) deviation of the scapula; adduction (pectoral) with equally marked lateral deviation. Abduction was limited, the arm not being carried out from the trunk beyond an angle of 45°. Adduction on the other hand was powerful and complete.

The motion of the elbow permitted all the portion of the limb placed distally to the joint to be moderately extended. At the end of extension the elbow was distinctly angulated. At the end of flexion the forearm and hand are doubled up to the median side of the humerus. The terminal phalanx when the limb was at rest was strongly adducted, and a re-entering angle was formed between the median border of the first and the second phalanx. When the limb was flexed this angle was directed upward and outward; but when the limb was extended it was directed outward. From this circumstance it may be said that the flexion and extension at the elbow-joint was accompanied with sub-rotation.

Together with the primal or congenital defects numerous acquired ones were present. The most conspicuous of these was a lateral deviation of the vertebral column to the right, the result probably, of the unantagonized traction of the muscles of the right side, and in part also to imperfect

ossification in the bones comprising the column. As a result of this deviation the scapula of the left side was displaced and the angle lodged *behind the upper border of the ilium*. It thus appeared to be wedged down in the pelvis. A second acquired defect was found in the muscles of the buttock and the back of the thigh. The gluteus maximus of each side was feeble, and in no position of the body became tense. The entire labor of holding the trunk erect was thrown upon the hamstrings which, particularly the biceps flexor, was on each side of enormous size.

Under the head of *habits*, the result of the defects described, may be included the manner by which the subject could attend to acts of the toilet and to the handling of tools, etc. Like most persons whose arms are either defective or absent, the toes and lips become highly functionalized, and the methods of their use are in this case no different from others recorded. Casey has supported himself, honorably, as a farm laborer and peddler; and has, for a period of years extending beyond the average longevity, preserved good health and character. For many years he was employed as a driver of oxen. The guiding staff was held by the powerful pectoral muscles between the arm and the chest. A nail can be driven with accuracy and force by placing the handle of the heavy hammer between the arm and the chest wall, holding the nail upright between the first and second toe of the left foot, and while standing erect on the foot of the opposite side, he flexes the left leg at the knee. In this position the body is supposed to be standing on the right leg, the left leg flexed and the left foot raised upon a bench or stool. The motion of striking the blow is secured by throwing the trunk suddenly forward from a position of backward traction or extension; the shoulder-muscle being occupied keeping the hammer in position between the arm and the trunk. The act of writing is accomplished by holding the pen between the flexed arm and the side of the head, the lips being used in guiding the pen. Other acts such as dressing, shaving, etc., are possible.

Remarks.—The modern method of studying congenital defects, as formulated by Meckel and St. Hiliare, father and son, is based upon the assumption that every embryo exhibiting an aberrant disposition of parts is an example of perverted or arrested development. The school of St. Hiliare accepts the conclusions that such perversions and arrests are exhibitions of and reversions to the characteristics of lower animals.*

While these statements cannot be in all respects controverted, an error is prevalent as to the systematic value of aberrant structures. An exam-

* "These (specimens) compose organic entities perfectly characteristic, amenable to law but placed in another kind of regular arrangement. When monsters are thus rigorously determined, I propose to group them after the zoological method and to determine for them genera and species." (Etienne Geoffroy St. Hiliare, Ann. Sc. Nat. xiv, 1828, 408.)

"An animal exhibiting anomaly which is essentially the same in structure as a part normally developed in a lower form, may be said to be degraded, and thus to have taken on the characters of creatures lower in the scale than itself." (Isodore Geoffroy St. Hiliare, Propositions, etc., 61.)

ple in the form above described, of a solidungulate extremity would suggest to the evolutionist a comparison with the foot of the horse; the single unguis, the nearly straight though multi-articulate axis from the unguis to the elbow, the main lines of motion, are identical in the two instances. But it is equally like the wing of a bird, and an analogy might be instituted with that limb: the extreme degree of flexion possible between the two main segments, the presence of two bones in the forearm, are the same in both. Such a method of comparison is no more conclusive than the likeness of clouds to camels and to whales. We can say with Polonius, such things are very like, and yet be no nearer in the end to a conclusion than in the beginning. The real comparison and only comparison which is profitable to make is with the general history of the superior extremity studied as a distinct subject, no matter what special form of limb may be differentiated in various animals. The presence of the exostosis upon the humerus is in this way comparable to other spinous outgrowths such as are seen in long slender shafts (as in the ribs of fish and of birds), and in many examples of diseased and perverted action in the long bones of man.

While such strictures are applicable to the various regions of the body, they cannot be made to apply to the subdivisions of a given anatomical system. The variations in the muscular system of man, for example, are often precise instances of reversion to the normal arrangement as met with in lower forms. In this way the study of minute variations in the shape of a muscle, or in the distribution of a nerve or a blood vessel, is more valuable for the purpose of the student of evolution than is the investigation of monstrous deformations.

Stated Meeting, January 18, 1884.

Present, 17 members.

President, Mr. FRALEY, in the Chair.

The resignation of Dr. William Camac was received in a explanatory letter dated Woodvale, January 7, 1884, and, on motion, accepted.

The receipt of the Zeisberger and Perlæus MSS. was acknowledged by letter, signed Edmund de Schweinitz, dated Bethlehem, January 7, 1884.

Letters of acknowledgment were received from the Anthropological Institute of Great Britain and Ireland (110–112), and Yale College (XV, i).

Letters of envoy were received from the Geological Survey of India, U. S. Coast Survey and Smithsonian Institution.

Donations for the Library were received from the Societies at Batavia, Bonn and Freiburg; the Geological Survey of India; the Society of Antiquities, Copenhagen; Royal Society, Upsal; Meteorological Institute, Vienna; Royal Academy and Bureau of Statistics, Brussels; Geographical Societies at London, Paris and Bordeaux; Geological Societies at Dresden and London; Nature; American Journal Science; Franklin Institute; College of Pharmacy; Profs. H. C. Lewis, E. D. Cope and H. Phillips, Jr.; Wyoming Historical Society; U. S. Coast Survey; Fish Commission; National Museum and Dr. Alex. Graham Bell.

The death of Strickland Kneass, at Philadelphia, January 14, 1884 (born July 29, 1821), aged 62 years, was announced, and the President empowered to appoint a member to prepare an obituary notice of the deceased.

Dr. Thos. G. Morton was appointed by the President to prepare an obituary notice of Dr. Kirkbride.

Mr. Wm. V. McKean, for that of Gen. Kane.

Mr. H. L. Carson, for that of Gen. Humphreys.

Prof. Cope exhibited fossil specimens of genera and species of the family of the *Oreodontidæ*, and described their characteristic structure and geological relations.

Commodore E. Y. McCauley's colored drawing of a sarcophagus in Memorial Hall, Fairmount Park, Philadelphia, was exhibited by the Secretary, who described the legends on its cover, translated by Com. McCauley.

Dr. Frazer communicated a table of barometric levels taken by him recently in Texas and New Mexico, and described the geological structure of the neighborhood; also, specimens of Maguëy needle and thread; and a specimen of the cheap handmade waterproof Mexican blanket. Prof. Cope remarked that the valley formation was Tertiary.

Mr. Lesley was elected Librarian for 1884.

The Committee on Mexican MSS. was continued.

The following *new members* were elected:—

Prof. Wm. L. Stevens, of Brooklyn, New York.
Prof. Henry M. Baird, University of the City of New York.
Hon. William D. Kelley, of Philadelphia.
Col. James Worrall, of Harrisburg, Pa.
Mr. Heber S. Thompson, C.E., of Philadelphia.
Prof. John M. Maisch, M.D., of Philadelphia.
Capt. Richard Mead Bache, U. S. C. S., Philadelphia.
Prof. John Ashhurst, M.D., of Philadelphia.
Hon. George H. Boker, of Philadelphia.
Hon. James R. Ludlow, Judge Court Common Pleas, Phila.
J. Solis Cohen, M.D., of Philadelphia.
Mr. Henry Flanders, of Philadelphia.
Hon. Richard Vaux, of Philadelphia.
Prof. Ellerslie Wallace, of Philadelphia.
Prof. Isaac Sharpless, Haverford College, Pa.
Col. William Ludlow, Chief Eng., Water Dep., Philadelphia.
Prof. John Bach McMaster, University of Pennsylvania.
Lord Coleridge, Chief Justice of England.
Prof. Allen C. Thomas, Haverford College, Pa.
Rev. Jesse Y. Burk, Gloucester co., N. Y., Sec. B. I. Un. Pa.
Mr. Isaac Burk, of Philadelphia.
Prof. M. B. Snyder, Central High School, Philadelphia.

Stated Meeting, February 1, 1884.

Present, 13 members.

President, Mr. FRALEY, in the Chair.

Letters accepting membership were received from Henry M. Baird, James Worrall, Heber S. Thompson, R. Meade Bache, John Ashhurst, George H. Boker, Richard Vaux, Isaac Sharpless, Wm. Ludlow, John B. McMaster, Allen C. Thomas, Jesse Y. Burk, Isaac Burk, and M. B. Snyder.

A letter declining membership for sufficient reasons was received from Henry Flanders.

Letters of acknowledgment were received from the Tacubaya Observatory, Mexico (110, 111), and the Franklin Institute (113).

Letters of envoy were received from the Central Physical Observatory of Russia; the Ministry of the Dutch Colonies, through the Department of State, U. S., Washington, D. C., January 25.

A letter requesting full exchanges was received from the Johns Hopkins University, dated Baltimore, January 26.

On motion, the Secretaries were authorized to furnish back volumes and numbers of Transactions and Proceedings to the Johns Hopkins University.

A letter requesting information was received from the Oneida Historical Society, dated Utica, New York, Jan. 29.

A letter respecting the discovery of Penn MSS., and requesting information was received from John Lyon Denson, dated 21 Upper Northgate Street, Chester, England, January 11. The subject was referred to the Secretaries to report action.

Donations for the Library were received from the government of the Dutch Colonies and the Society at Batavia; the Geological Survey of India; the Imperial Austrian Academy; the Statistical Bureau of Sweden; the German Geological Society; Fortschritte der Physik and Garten Zeitung; the Leo. Car. Academy of Science; the Geological Society at Dresden; the Societies at Greifswald, Freiburg and Bonn; the Danish Academy and Society of Antiquaries; the Belgian Academy; M. Henri de Saussure, of Geneva; the Academia dei Lincei; the National Academy and Geographical Society at Bordeaux; the Zoölogical and Anthropological Societies and Ecole Polytechnique, Revue Politique, and Science et Nature; the Meteorological and Astronomical Societies in London, and London Nature; Dr. T. S. Hunt; the Boston Natural History Society, and American Academy of Sciences; the Museum of Comparative Zoölogy, and Cambridge Observatory; Magazine

of American History; Franklin Institute, Academy of Natural Sciences, Board of Health, Richard Vaux, Lorin Blodget and H. Phillips, Jr.; the Johns Hopkins University; U. S. National Museum; Dr. Peter, of Frankfort, Kentucky; Isaac Smucker, of Newark, Ohio, and the Statistical Bureau of Mexico.

Professor Cope exhibited specimens and described his classification of the fossil *Creodonta*.

The President reported that he had appointed the following Standing Committees for 1884:

Finance.

Eli K. Price, Henry Winsor,
J. Price Wetherell.

Publication.

D. G. Brinton, G. H. Horn,
C. M. Cresson, Persifor Frazer,
J. Blodgett Britton.

Hall.

J. Sergeant Price, Wm. A. Ingham,
C. G. Ames.

Library.

E. K. Price, Henry Phillips, Jr.,
E. J. Houston, Wm. V. McKean,
Thomas H. Dudley.

The President reported that he had received and passed to the Treasurer the quarterly interest of the Michaux legacy, last due, amounting to $133.07.

The Committee on Aztec MSS. reported that they had reclaimed some of them for publication.

Mr. Phillips offered a resolution respecting the order of business, which was, on motion, referred to the Board of Officers and Council.

Stated Meeting, February 15, 1884.

Present, 12 members.

President, Mr. FRALEY, in the Chair.

Messrs. Parrish, Ashhurst and Cohen, new members, were introduced to the presiding officer and took their seats.

Dr. Maisch accepted membership by letter, dated Philadelphia, February 17.

Letters respecting missing publications were received from the Batavian Society at Batavia, the Geological Society of France, and the Johns Hopkins University. (See rough minutes.)

Letters of enquiry respecting publications were read from Mr. D. Lyman, of the U. S. Revenue Department, and Prof. A. L. Guss, of the U. S. Treasury Department; and a letter of envoy from Col. Jas. Worrall, of Harrisburg.

The Lee MSS., 2 Vols., having been returned to the Library, the Librarian read a letter of explanation from Mr. Justin Winsor, dated Cambridge, Mass., Feb. 9.

Donations for the Library were reported from the Geological Survey of Victoria; Revue Politique; Geographical Societies of Paris and Bordeaux; Annales des Mines; R. Academy of History, Madrid; Revista Euskara; London Nature, R. A. Peacock, and B. Ward Richardson; the Glasgow Philosophical Society; the Geological Survey of Canada; the Boston Natural History Society; Museum of Comparative Zoölogy; American Antiquarian Society; American Journal of Science; Astor Library; Academy of Sciences and Prof. J. S. Newberry, of New York; American Journal of Pharmacy, and Numismatic and Antiquarian Society; Col. Jas. Worrall, of Harrisburg; the U. S. Naval Institute; the U. S. War Department, and Mr. H. Phillips, Jr.

The death of Arnold Guyot, at Princeton, N. J., February 8, 1884, aged seventy-six years and four months, was reported,

and the President requested to appoint a member to prepare an obituary notice of the deceased.

An obituary notice of Dr. Robert Bridges was read by Dr. Ruschenberger.

Mr. Blodget described the transfer of certain manufacturing industries from England to Philadelphia.

Sections of the Anthracite Coal Measures, recently executed by the Geological Survey of the State, were exhibited.

Dr. Frazer exhibited copies of prehistoric hieroglyphs, found in the Puerco San Antonio, Coahuila, Mexico, 25 S. E. of Coahuila, not previously described, sharply cut. Also, his discovery of a granite sacrificial stone, of great weight and age, lying sixty or seventy miles distant from any rock of that kind in the region. Size, 5′, 6″ by 3′, and 4′ high; shape peculiarly curved; edges full of fine sharp serrations; weight at least five and a half net tons. A natural ravine cut in the stone would allow the blood to flow off without overflowing the stone. The locality is a narrow mountain pass, which has a history both ancient and modern.

The minutes of the last meeting of the Board of Officers were read and their consideration postponed.

The Committee on Aztec MSS. reported progress.

Stated Meeting, March 7, 1884.

Present, 12 members.

Vice-President, ELI K. PRICE, in the Chair.

Mr. Lehman, Mr. Isaac Burk and Professor Pancoast were introduced to the presiding officer, and took their seats.

Acceptance of membership was reported from Dr. Ellerslie Wallace, Dr. J. Solis Cohen and Lord Coleridge.

Letters of acknowledgment were received from Le Ministère des travaux publics (Annales des Mines), February 4

(XVI, i; want XIV, ii, and 97 and 100); the Society of Natural Science, Cherbourg, January 31 (113; want 16, 37, 46); the Royal Institution, London, February 2 (XVI, i, 113); the Society of Antiquaries, London, February 20 (XVI, i, 113); the University Library, Cambridge, February 14 (113); Radcliffe Observatory, March 7 (XVI, i, 113); Cambridge Philosophical Library, February 11 (XIII, i; XIV, ii; XVI, i, 62, 71–3, 113); Essex Institute (114); New Hampshire Historical Society, Concord (114); American Antiquarian Society, Worcester, Mass. (114); Brown University (114); Connecticut Historical Society (114); W. P. Blake, New Haven (114); University of the City of New York (114); Prof. J. J. Stevenson (114); Astor Library (114); United States Military Academy (114); Chemical Society, University Building, Washington Square, New York (114); New Jersey Historical Society (114); Historical Society of Pennsylvania (114); Numismatic and Antiquarian Society of Philadelphia (114); Mr. Henry Phillips, Jr. (114); Prof. Thomas C. Porter, Easton, Pa. (114); Wyoming Historical and Geological Society (114); Rev. Joseph A. Murray, D.D., Carlisle, Pa. (114); Asaph Hall, Washington (114); Theo. Gill, Washington (114); William B. Taylor, Washington, D. C. (114); J. M. Hart, Cincinnati (114), and the University of Michigan (114).

Letters of envoy were received from the Philosophical Society, Washington; the Netherlands Legation and Henry B. Dawson, of Morrisania, N. Y.

Donations to the Library were reported from the Asiatic Society of Japan; the Society at Wiesbaden; Royal Academy, Brussels; Flora Batava; Royal Academy, Rome; Geographical Society, Bordeaux; Geographical and Ethnographical Societies at Paris; Revue Politique; Congrès des Orientalistes; Royal Astronomical Society and London Nature; Geological Survey of Canada; Essex Institute; B. S. Lyman, of Northampton, Mass.; Museum of Comparative Zoölogy; Harvard University; Prof. Henry Draper; Boston Society of Natural History; Science Record; American Journal of Science; Buffalo Society of Natural Sciences; Franklin Institute;

American Journal of Pharmacy; Pennsylvania Magazine; American Bar Association; Mercantile Library, Philadelphia; Haverford College; Wyoming Historical and Geological Society; Second Geological Survey of Pennsylvania; Pennsylvania Secretary of Internal Affairs; Richard Vaux, of Philadelphia; American Journal of Mathematics; United States Light-house Board; Bureau of Education; Dr. Hayden's Geological Survey; Colonel Charles W. Whittlesey; American Antiquarian Society, Chicago; Richard Mansill, Rock Island; the University of Michigan; Wisconsin State Historical Society; and the San Francisco Mercantile Library Association.

A letter from Mr. Jedediah Hotchkiss, Staunton, Va., was read, requesting permission to have photographs taken of the plates of the Natural Bridge from DeChastellux's Travels in North America; the photographing to be done in the rooms of the society. On motion, the request was granted.

The death of Prof. George Englemann, at St. Louis, February 11, aged seventy-five, was announced.

Mr. Lesley was appointed to prepare an obituary notice of Professor Guyot.

Professor Cope read a paper entitled, On the structure of the skull in the Elasmobranch genus *Didymodus*.

Mr. Ashburner presented some notes "On aneroid hypsometry," and exhibited a self-registering field instrument.

Mr. Hotchkiss explained his request regarding pictures of the Natural Bridge, and spoke of the fine photographs recently made of it by order of Mr. Kemble, 333 Walnut street, Philadelphia.

Pending nominations, Nos. 1012, 1013, and new nominations, Nos. 1014, 1015, were read.

OBITUARY NOTICE OF DR. ROBERT BRIDGES.

By W. S. W. Ruschenberger, M.D.

(*Read before the American Philosophical Society, Feb. 15, 1884.*)

A man whose honest conduct and toil through a long life contribute, in any marked degree, towards the comfort, or enlightenment of his fellows, or the good name of the community in which he lived, earns a claim to kindly remembrance after he has left the field of his labor forever. It is good for the living to know something of his ways and services, though he may not have won a foremost place among the leaders of science or of letters. Even an imperfect sketch of the life of a man who has striven to increase or to diffuse knowledge, is more or less valuable, because it may incite others to emulate his example, and toil patiently among followers till qualified to fill a chief's place. If the reputation of a workman is in proportion to the quality and quantity of his work, then a fair relation of what Dr. Bridges has done will suffice to secure, without aid of rhetoric, the degree of encomium which his life deserves in this connection. A kind and generous disposition enhanced the merit of his work. He did much that brought no pay beyond the satisfaction which comes from doing to help others, and to contribute to the common progress. His life was characterized by uniform, unremitting labor.

The details of this sketch may be somewhat tiresome, but as they contain the gist, all the testimony in the case, they may be patiently heard at least, if not excused.

The ancestry of Dr. Robert Bridges is traced to Edward Bridges who, in 1648, was a lieutenant of the English army. Edward, his eldest son, who was an architect, married in 1692. He left two sons. The elder, named Edward, married Catherine Bullen. He was a merchant in Cork. He had six sons and two daughters. Edward, the eldest of the sons, who also was a merchant in the city of Cork, married a second wife in Rotterdam, Cornelia, the second daughter of Thomas Culpeper, of Kent county, England. By her he had four children.

Edward, their third son, settled in Philadelphia, and, in 1739, was established at a corner of Front and Walnut streets, in the dry goods trade. His place of business was commonly called "the Scales."

He left three sons: Edward John, who was born in Rotterdam, in 1736, and died in Jamaica, surgeon of the *Africa*, a sixty-four gun ship; Culpeper, who died a midshipman on board of the *Northumberland*, at the siege of Louisburg, Cape Breton, 1758, and Robert, who was born in Philadelphia, November 18, 1739, and married, in 1769, Jemima Sheppard, of Bensalem township, Bucks county, Pa. He had five sons, Barnsley, Robert (who probably died young), Culpeper, Robert and Edward; and five daughters, Cornelia, Mary, Sarah, Harriet and Emily.

Robert Bridges was a sailmaker. His residence was at (old number) 259 South Front street, and his sail-loft was on the wharf, Delaware avenue, north of Lombard street. James Forten, an almost "colorless colored man," was his foreman, and, in 1800, when Robert Bridges died, succeeded him in business.

Culpeper Bridges, the third son of Robert, the sailmaker, was born in Philadelphia, December 21, 1776, and died December 29, 1823. He was trained to be a merchant by John Leamy, whose "counting-house" was at the south-east corner of Walnut and Third streets. He married, February 21, 1804, Sarah, the fifth daughter and eleventh child of William Clifton, of Southwark, a blacksmith and machinist, and had two sons, William Clifton, and Robert, the subject of this sketch, who was born in Philadelphia, March 5, 1806.

We are what our mothers make us, and therefore it seems proper to state that the iron master, William Cliffton was born, probably in Philadelphia, March 4, 1729, and died February 24, 1802. He married, September 2, 1763, Catherine Hallowell, by whom he had twelve children in the course of less than nineteen years. She died July 16, 1786. They were all members of the Society of Friends. One of the sons, William, who died November 25, 1799, was a poet as well as blacksmith. It

was said that he was "read out of meeting," expelled from the society, for the reason that he indulged in the frivolity of writing verses. If no other cause of expulsion existed, it is demonstrable that Friends of the present time are not so austere as they were then. But there is proof that other reasons probably influenced the decision. The preface of a volume of "Poems, chiefly occasional, by the late Mr. Cliffton," printed for J. W. Fenno, in 1800, claims that he was "an expert swordsman, a scientific and admirable musician, an accomplished painter and a graceful dancer," clearly showing that his acquirements were of a kind not likely to be commended in the community of Friends.

William Cliffton, blacksmith, resided, 1785, in Water street between Almond and Catharine streets,* and in 1797, at No. 74 Swanson street.† About this date he seems to have transferred his business to his sons, William and John, for the City Directories of 1798, and subsequent years, give his residence at No. 76 Swanson street, and style him "gentleman," a term used in those days to designate a man of income sufficient to live at ease without work or a vocation.

This outline of lineage, which is purely English, implies that the ancestors of Dr. Bridges were vigorous, enterprising, intelligent, industrious and respectable.

Both sons were liberally educated, both were pupils in the University Grammar School. William Cliffton graduated from the department of arts of the University of Pennsylvania in 1821. Robert was for a short time one of the sophomores of the University—there was no freshman class at that period—and then, for no assigned reason, entered Dickinson College, Carlisle, Pa., from which he graduated 1824. In July of the same year he was elected a member of the Societas Philosophiæ Consociata of the College.

Immediately after his return to Philadelphia he became a pupil of Dr. Thomas T. Hewson, and remained under the

*The Philadelphia Directory, by Francis White, made up to September 1, 1785. It was the first work of the kind published in the city. Up to that time numbers had not been attached to the houses.

†Philadelphia Directory, by Cornelius William, Stafford, 1798, 1802.

instruction of that eminent medical teacher and surgeon nearly four years. He had associated with him, in teaching his large class of students, several assistants. His office was a two-storied house, on the north side of Library street near to Fourth street. In it were a students' reception-room, a laboratory and a lecture room, and, in the rear of the house, a dissecting-room.

In Dr. Hewson's private medical school Dr. Franklin Bache taught chemistry. He appointed young Bridges his assistant very soon after he began his medical studies. In this capacity he served Dr. Bache through many years, in the courses of chemical lectures delivered by him in the Franklin Institute, in the Philadelphia College of Pharmacy, and at the Jefferson Medical College. This practical training made him an expert chemist and an admirable teacher of chemistry.

His close attention, habitually given to whatever he might be doing, qualified him in a high degree to assist the lecturer on chemistry. In May, 1827, upon pouring water into an iron mercury flask, which had been used for obtaining oxygen from nitre, for the purpose of washing it, he noticed a lively effervescence. He proceeded at once to investigate the nature of the gaseous matter, and found it to consist of oxygen of a purity of ninety-five per cent, as he ascertained by Dr. Hare's accurate sliding-rod endiometer. He observed the same phenomenon, November 27, at the Franklin Institute, and found in this instance that the oxygen contained only one per cent of impurity. He suggested that this residuum, which Dr. Hare conjectured to be peroxide of potassium, would furnish pure oxygen to the experimenter without trouble. He was anticipated in this discovery. Mr. Richard Philips, of London, had made the same observation and given the same rationale of the phenomenon, an account of which he published in the *Annals of Philosophy*, for April, 1827. Nevertheless, Dr. Franklin Bache, published in the *North American Medical and Surgical Journal*, for January, 1828, a note of the observation of "Mr. Robert Bridges, student of medicine," on the "Residuum of Nitre after exposure to red heat."

The circumstance indicates his character as a student and at the same time Dr. Bache's kind appreciation of his worth.

Dr. Bridges graduated from the medical department of the University of Pennsylvania, March,1828. "Neuralgia" was the subject of his thesis.

He immediately opened an office at the south-east corner of Vine and Thirteenth streets, where he remained till 1837. He did not obtain a lucrative practice. His mother died, February 19, 1839, in the fifty-eighth year of her age, a loss generally among the saddest in man's experience.

A carefully prepared tabular record of 2099 cases of vaccination under his observation, between April 1, 1830, and May, 1840, indicates that he was a vaccine physician of the south-western district of the city during ten years. An ordinance of January 2, 1830, divided the city into four districts, designated as the North-eastern, North-western, South-eastern and South-western Districts, and directed the Mayor to appoint a vaccine physician to each on the first Monday of January every year.*

The Board of Health appointed Dr. Bridges, July 17, 1832, the cholera year, one of the attending physicians in the district which included the Eastern Penitentiary, then at the north-west corner of Broad and Arch streets. The work was arduous. Entire nights were passed in the prison ministering to cholera patients. The remuneration for this perilous service was very small.

Dr. Bridges was a constituent member of the Friday Evening Medical Club, which was formed in 1835 or '36, and ceased to exist about 1872. The meetings were held, in turn, at the houses of the members. The entertainment was limited to tea, coffee and biscuits. The object of the club was to promote social intercourse among members of the medical profession in the city.

He was elected a member of the Academy of Natural Sciences of Philadelphia, January 1835; of the Franklin Institute, Jan-

* Vaccine physicians were appointed in the Northern Liberties under an ordinance of May 15, 1820, and in Kensington, under an ordinance of December 4, 1822.

uary, 1836; a resident member of the Philadelphia College of Pharmacy, December, 1838; a fellow of the College of Physicians of Philadelphia, July, 1842; and he was chosen a member of the American Philosophical Society, January 19th, 1844.

He was a councillor of the Society from January, 1855; chairman of its publication committee six years, from 1860, and served on many special committees.

His first work in the Academy of Natural Sciences was the preparation, in conjunction with Dr. Paul B. Goddard, of an Index of the genera of the Herbarium, which was presented August, 1835. He served on the Botanical Committee twenty-one years, from January, 1836. In May, 1843, he presented a new Index of the Academy's Herbarium, and an Index of Menke's Herbarium, works which were long the main guides to the Academy's botanical collections.

He was librarian from June, 1836, till May, 1839, when he resigned. The thanks of the Society were presented to him for "his able and efficient discharge" of the duties of the office.

He served as Recording Secretary five months in 1839 and '40; and as Corresponding Secretary from May, 1840, till December, 1841. He was an Auditor six years, from December, 1843, one of the Vice-Presidents more than fourteen years, from September, 1850, and was elected President, December, 1864. He declined re-election December, 1865.

He served twenty-three years on the Publication Committee, declined re-election in 1872; twenty-nine years on the Library Committee, from December, 1842; seven years on the Committee on Proceedings; five years on the Committee on Finance; seventeen years on the Committee on Entomology and Crustacea. He labeled and arranged anew the collection of crustacea according to the nomenclature and classification accepted at the time as the best. He was a member of the Committee on Herpetology and Ichthyology nine years, from January, 1857; on Physics ten years, from January, 1866; on Chemistry five years, from December, 1870, and a member of the Council more than five years, from December, 1869.

When the Academy's building was extended in 1846, and the extended building was raised and improved in 1855, he served on the building committees, and aided in obtaining subscriptions for the work on both occasions.

Again, December, 1865, Dr. Bridges was appointed a member of a committee to solicit subscriptions to erect a fire-proof building for the use of the Academy; and, January 8, 1867, he was elected one of the Board of Trustees of the Building Fund, and by it a member of the Building Committee, January 11, 1867, on which he served faithfully until the Society was established in its new quarters, January, 1876.

The official positions to which he was annually elected, his appointment to several standing and many special committees, imply that he had the respect and unreserved confidence of his fellow-members. Among them none was more constant, none who worked more industriously. He promptly discharged all duties imposed upon him and, during forty years, was seldom absent from the meetings of the society. In addition to his valuable services, he contributed to its funds, to its library and its museum as liberally as his modest income justly allowed.

As a token of their estimate of his worth, a number of members presented to the Academy a portrait of him which, painted by B. Uhle, an eminently skillful young artist of this city, will soon be hung in place among the portraits of the presidents of the society.

His remarks "On infusoria found in stagnant water" are reported in the Proceedings of the Academy for May, 1842; on "The influence of the contact of copper in preserving human bones," and on "Indian reliques," May, 1843; on "Estimates of the length of the year," and on the "Formation of lithoid carbonate of iron," in the volume for 1848.

At the Franklin Institute Dr. Franklin Bache taught chemistry, as lecturer and professor,* from September, 1826, till 1831. During the whole period, five years, Dr. Bridges was his assistant. After that time he did not participate in the

* Dr. Bache was appointed lecturer on chemistry, September, 1826, and professor, March, 1828.

proceedings of the Society though he was occasionally present at its meetings.

As already stated, he was an active and prominent member of the Academy of Natural Sciences, but all his time was not given to it. He labored most earnestly in another institution, the Philadelphia College of Pharmacy, with which his career was so closely associated, that, to understand it clearly, a statement of the circumstances which attended the origin and progress of the College seems necessary.

A National Convention of Physicians assembled at Washington, D. C., January 1, 1820, for the purpose of devising a code of formulas, and establishing it as the sole standard for medicinal preparations. The object was to have them made exactly alike in composition and strength by all physicians and apothecaries throughout the land.

At that period the London, the Edinburgh, the Dublin and other pharmacopœias were recognized authorities in the United States. Their directions were not alike. Therefore, as every apothecary followed the standard he considered best, officinal preparations of the same name, found in the shops, differed from each other just as the standards differed. The composition and potency of the physician's prescription were contingent, in an important degree sometimes, upon the pharmacopœia followed by the apothecary who dispensed it.

It is obvious that the interest of both patients and physicians required that these several authorities should be superseded by a single standard. To attain this end, to establish a permanent authority in the premises, and obtain for it general confidence and respect everywhere in the United States, it was determined that a national convention composed of delegates from the medical colleges and incorporated medical societies of the country should be convened every tenth year; that each delegation should be invited to submit to the convention a report of suggested amendments to the work; that from the reports presented the convention, through the agency of a select committee appointed for the purpose, should compile and publish a revised edition of the Pharmacopœia every ten years. An

advantage of this plan is, that each revision represents at the date of publication the common opinion of the profession, and the work is kept in accord with the progress of pharmacy and of medical knowledge.

The result of the labors of the convention of January, 1820, was the publication, at Boston, Mass., December 15, 1820, of the first Pharmacopœia of the United States of America, and since, of decennial revisions of it, the sixth of which is now in use.

The achievement is notable. The pharmacopœia of every nation of Europe is a public work directed and paid for by the government. Without the influence of a statute of any kind to sanction or enjoin its use, this, through the force of public opinion created in its favor, has been established as the law, the standard in the premises, which is generally respected.

The work is purely charitable. It has been done, for threescore years at least, at the cost of the labor, time and money of many medical men without any compensation to the workmen for their work; and the results of it have been freely given for the common good.

Dr. Bridges was among the most skillful of those who labored to perfect the Pharmacopœia. The Philadelphia College of Pharmacy appointed him, March, 1847, one of a committee to revise the issue of 1840, and prepare the report on it to be given to the National Convention of 1850, the first in which pharmacists were represented. He assisted on a committee of the College of Physicians, appointed February, 1868, to report on the fourth decennial revision; was one of the delegates from the college to the meeting of the National Convention of 1870, and was a member of the committee on publication of the fifth decennial revision. In July, 1877, the College of Physcians appointed him one of a committee to revise the Pharmacopœia of 1870, and prepare a report on it for the National Convention of 1880.

The labor of those committees of revision is considerable. Inspection of materials, pharmaceutical experiments and therapeutic observation are often necessary to determine the value

of a formula. Each committee held weekly sessions of about two hours, and, on an average, required two years to complete its work. All the institutions which participate in the preparation of a revised edition of the Pharmacopœia, give it like attention, so that it is not easy to conjecture the aggregate of labor bestowed upon it. So much care merely signifies that, in the estimation of the profession, accuracy in all the details of the work is very important.

About the time when the first National Convention met, the drug and apothecary business was regarded as a trade, rather than as a profession based on scientific principles, as it is now. It was known that deteriorated drugs were sold, and that valuable preparations in daily use were adulterated or made of materials of inferior quality. Such abuses were charitably ascribed to ignorance of pharmacy which was supposed to prevail among druggists and apothecaries generally.

To remedy this lamentable condition of the apothecary's vocation, some three-score of intelligent, philanthropic men, including a large proportion of members of the Society of Friends, associated in this city and founded, February 23, 1821, the Philadelphia College of Pharmacy, a society which was incorporated, March 30, 1822, with all legal authority necessary to establish and support a school of pharmacy.

The University of Pennsylvania had then recently provided for teaching pharmacy in connection with materia medica, and conferring the degree of Master of Pharmacy, which was conferred the first time in the spring of 1821 on sixteen graduates. This action of the University, it was said, greatly influenced, if it did not determine the formation of the Society known as the Philadelphia College of Pharmacy.

It consists of active or resident, honorary and foreign members. The conduct of its ordinary affairs is confided to sixteen trustees, one-half of whom are elected semi-annually by the college. The stated meetings of the board of trustees are monthly, and of the college, quarterly.

The first courses of lectures, which were limi ted to materia medica and chemistry, were given in the winter of 1821–22,

but the degree of "graduate of pharmacy" was not conferred till the spring of 1826, when there were three graduates.

The lectures were delivered in a building on the west side of seventh, between Market and Chestnut streets, the site of which is now occupied by the Gas Office of the city.

In 1832 the society erected for its use a building on the south side of Zane, now Filbert street, west of Seventh, and occupied it until the college was established in its present well adapted quarters, No. 145 North Tenth street, September, 1868.

Under the authority of the Society, the *American Journal of Pharmacy*, which is devoted to the advancement of pharmaceutical knowledge, and the advocacy of thorough education of pharmacists, was established in 1825. It was issued quarterly, till 1853, then bi-monthly till 1871, since that date monthly, and continues to be a prosperous periodical.

Dr. Bridges was assistant editor of this journal about six years, from 1839 till 1845, and contributed several original papers to it.

The college grew very slowly. But the strict probity observed in its management and the great care taken to select only the most competent and conscientious teachers, have enabled it to surmount all impediments in the way of its progress.

Now, graded courses of instruction are given on materia medica, botany, the theory and practice of pharmacy, chemistry (practical and analytical), and pharmaceutical manipulation, by a faculty consisting of four professors and three assistants. The teaching is very thorough. Since the establishment of the school 7109 students have matriculated; upon 2049 of whom, 28.82 per cent., the degree of graduate in pharmacy has been conferred.*

Dr. Bridges entered the college, May, 1831, as private assistant of the professor of chemistry, Dr. Franklin Bache, and was elected an active member of the society December 18, 1838, and, March 25, 1839, a member of the Board of Trus-

* Sixty-third Annual Announcement of the Philadelphia College of Pharmacy, 1883.

tees, and also of the Publication Committee, to which he was annually elected, till 1861, twenty-one years, when he declined re-election. He was elected chairman of the Board of Trustees, October 9, 1860, and, being annually re-elected, held the position till the close of his life.

When Dr. Bache gave up the chair of chemistry to take the professorship of the same department in the Jefferson Medical College, Dr. Bridges was a candidate for the vacant place, but Dr. William R. Fisher was elected, May 31, 1841, by a majority of two votes. He resigned the following April, and Dr. Bridges was unanimously elected Professor of General and Pharmaceutical Chemistry, May 16, 1842. Still he continued to be the private assistant of Dr. Bache, till his death, in 1864, severed their continuous laboratory association of forty years. Dr. Bridges, also aided Dr. George B. Wood in his work while he held the professorship of materia medica in the University of Pennsylvania, from 1835 till 1850.

Besides the routine work of the professorship, Dr. Bridges did his full share on standing and special committees, delivered many introductory and other addresses, and represented the College among its delegates to the American Pharmaceutical Association and other bodies.

It is related substantially that, prior to 1851, the average number of graduates annually, from 1826, was less than seven, and that the public commencements were biennial. That year the matriculants numbered 82, and the graduates 19. The class determined that the commencement should be attended with more demonstration than had been made on previous occasions. The ceremonies had been conducted in an apartment of the college, not capable of seating comfortably a hundred persons. Other arrangements were proposed, but opposition to them from an unexpected quarter was strong. The president and some of the trustees of the college belonged to the Society of Friends. They are notably conservative of their customary ways and averse to ostentation. The commencement had consisted in the delivery of diplomas to the graduates by the president according to a prescribed form, and a suitable

address by a professor in the presence of invited friends. The ceremony was sedate, without manifestation of that sense of triumph which successful young candidates are supposed to feel on such an occasion. As many Friends regard the fine arts, painting and sculpture, as frivolities, things not only unnecessary to happiness, but in their influence detrimental in some indefinite way to a proper observance of purely moral life; and music, by its charms, as likely to allure to evil ways, to divert the mind from industry and the pursuit of substantial things, their aversion to the proposed display was entirely in harmony with their ancient opinions in this connection. Rather than assent to the proposed arrangements some of them resigned, or purposely were absent.

Nevertheless, the commencement was held, April 4, 1851, in Sansom Street Hall, in the presence of a large audience, attended by a band of good music. Those most concerned were highly pleased. The vacancy caused by the resignation of the president was well filled on the occasion by Dr. Bridges, who conferred the degree of "graduate of pharmacy" on those entitled to the honor.*

The painstaking and kindly ways of Dr. Bridges in teaching, won for him affectionate and enduring respect from those whom he taught. At the commencement, March, 1867, a portrait of him, in oil, was presented to the college by the Phi Zeta Society; and the graduating class, at the commencement, March, 1877, presented to him a stem-winding gold watch.

The additional labor imposed by adopting the method of teaching in graded courses, induced Dr. Bridges, in June, 1878, to procure an assistant. And in January, 1879, at a meeting of the Board of Trustees, he stated informally that his impaired health constrained him to announce that he would relinquish the chair of chemistry at the close of the course.

On hearing of his intended resignation, the graduating class of one hundred and fourteen members, representing eighteen States, held a meeting and adopted a preamble and resolutions,

*See The Annual Address before the Alumni Association of the Philadelphia College of Pharmacy. By James Stratton, Ph. G., 1879.

expressing regret, sympathy, and, for themselves as well as their predecessors, "profound respect for Dr. Bridges as a chemist, and their most grateful esteem for him as their friend and instructor," and earnestly invoking the divine blessing upon his remaining years.

He tendered his resignation in a letter dated March 4, 1879. At a meeting of the Board of Trustees, March 14, a preamble and resolutions were unanimously adopted, stating in substance that he had devoted his time and abilities to a conscientious discharge of the trust assigned him for a long period, during which the professors received a scanty remuneration, that "to his sound judgment and patient labor" the success of the college is much indebted; that the good work he has accomplished has its record in those who have been his pupils in the college —about five thousand—and that he has the sincere thanks and sympathy of the Board.

At the celebration of its twenty-fifth anniversary, March 11, 1879, the Phi Zeta Society, which is composed of alumni of the college, created a scholarship and named it the Robert Bridges scholarship, as a token of its high estimation of his character and official services.

The Board of Trustees after due deliberation, "in view of his faithful and efficient labors," conferred upon him, May 6, 1879, the title of Emeritus Professor of Chemistry, with an annual salary of one thousand dollars, to be paid in equal installments quarterly, in advance, during his life, from the first day of July ensuing.

By this spontaneous act of benevolence, the Trustees have shown themselves to be worthy of honor as distinguished as that which they conferred on Dr. Bridges; and they have set an example eminently proper to be followed by all incorporated educational institutions. There are no skilled laborers whose work is more important to the community, and yet none so inadequately paid, as professors and teachers in our colleges and schools of every name. During the vigorous period of their lives their remuneration affords them and their families a very modest living; but it is too scanty to permit investment of a

part of it annually to create resources sufficient for invalid days and old age, even after continuous toil during thirty or forty years. Possibly better than increased remuneration for these beneficent servants of the people would be a college fund from which those professors who have become incapable of performing their official duties, by age or otherwise, might receive a moderate pension or retired pay; at any rate the emeritus professor should have a salary.

When the professorship of chemistry in the Jefferson Medical College was vacated, in 1864, by the death of the incumbent, Dr. Bache, Dr. Bridges was one of seven candidates for the vacancy. It was filled by the election of Dr. B. Howard Rand.

While discharging, efficiently and most acceptably, his duties at the Academy of Natural Sciences, and in the Philadelphia College of Pharmacy, he found time to teach medical chemistry in the Philadelphia Association for Medical Instruction, to attend the meetings of the American Philosophical Society, and of the College of Physicians of Philadelphia, and render to it valuable service. He was one of its delegates to the National Medical Convention held in Philadelphia, May, 1847, and subsequently was one of the representatives of the college in the American Medical Association.

He analyzed the collection of one hundred and eighty-five urinary-calculi in the Mütter Museum, which belongs to the college, and made a catalogue of them.

In January, 1867, he was elected a member of the library committee and appointed librarian. The duties of the office occupied him daily from 11 o'clock, A.M., till 3 o'clock, P.M. In January, 1879, he declined re-election to the library committee, and failing health induced him to resign the office of librarian, January, 1881, having filled it during fourteen years. Then, on motion of Dr. DaCosta, it was unanimously resolved "that the thanks of the college be tendered to Dr. Bridges, for his long, faithful and intelligent services to the college, and that they deeply regret that failing health will deprive the college of his labors; that as a slight token of ap-

preciation of his long services, his annual dues be hereafter remitted." And at its stated meeting, January 26, 1881, the library committee presented to Dr. Bridges "the expression of their sincere regret that the care of his health obliges him to retire from the office of librarian, which he has held for so many years, and in which they have learned to appreciate his industry, fidelity and courtesy. They sincerely hope that he may find in repose and recreation the means of improving his health, and the opportunity of observing the growth of the library with whose early history he has been identified."

Cultivation and teaching of the medical sciences have ever been among the pursuits which contributed to the good name of Philadelphia. The excellence of the medical colleges in the city is generally acknowledged. This high character is ascribable, in some degree at least, to aspiring young physicians who joined together in little bands to lecture and teach the several branches of medicine while the incorporated colleges were closed. In past times this recess continued during six or seven months of the year. Those engaged in the summer schools, as they were called, soon became trained teachers, well qualified to fill professorships. Several of the most distinguished professors in our medical colleges were partly indebted for their appointment to the preliminary training, and reputation acquired in a summer school.*

In the spring of 1842, the Philadelphia Association for Medical Instruction was formed. The constituent members or founders of it were Dr. John F. Meigs, who taught obstetrics till 1845, and afterwards lectured on the diseases of children; Dr. Joshua M. Wallace, who taught surgery; Dr. Robert Bridges, chemistry; Dr. Francis Gurney Smith, Jr., physiology; and Joshua M. Allen, anatomy. Dr. Bridges, was the only constituent member of the Association who remained in it until it was dissolved at the close of 1860, a period of eighteen years.

*The History of the Philadelphia School of Anatomy and its relations to medical teaching. A lecture delivered March 1, 1875, at its dissolution. By William W. Keen, M.D. (published by J. B. Lippincott & Co.).

Many of the associations for medical teaching in Philadelphia are sketched or referred to in this very interesting paper.

Several retired to accept professorships in medical colleges, and their places were supplied by new appointments, so that during the career of the Association the names of many distinguished physicians are recorded on its list of members.*

Dr. Bridges was elected professor of chemistry in the Franklin Medical College in 1846, and filled the office till the institution was dissolved in 1848.

His contributions to medical and scientific literature are valuable, but not very numerous.

His papers in the *American Journal of Pharmacy* are entitled, "Chemical symbols," and "Pyroacetic spirit and its derivative compounds," in 1839; "The manufacture of sulphuric acid," and the "Adulteration of lac sulphuris," in 1840; "Notice of Professor Kane's researches on ammoniacal compounds," "Poisoning by long continued use of acetate of lead," in 1841; "Observations on two species of aristolochia which afford serpentaria," "Observations on the action of ether on galls," "Report on Procter's hydrated peroxide of iron," in 1843; "Experiments on the absorbing power of anthracite," "Precipitated carbonate of lime," "Solution of iodide of iron," "Solidification of carbonic acid," in 1844; "Pil hydrargyri," in 1846, and "Southern prickly-ash bark," in 1865.

In July, 1845, Dr. Bridges "edited with additions" the American reprint of Elementary Chemistry, Theoretical and Practical, by George Fownes, and subsequently several editions of this popular volume. The latest American, from the twelfth English edition of the work, was issued May, 1878.

He also edited, 1852, the American reprint of Graham's Elements of Chemistry.

From 1854 till 1877, inclusive, he contributed very many bibliographical notices and reviews, chiefly of works on chemistry, to the *American Journal of the Medical Sciences*.

* David H. Tucker, William V. Keating, J. H. B. McClellan, Ellerslie Wallace, Addinell Hewson, John H. Brinton, S. Weir Mitchell, Alfred Stillé, Morton Stillé, J. M. DaCosta, Francis West, James Darrach, and Edward Hartshorne, were teachers in this Association. Including the constituent members, a corps of better qualified instructors than those associated in this summer school could not be easily found anywhere.

He assisted Dr. George B. Wood in the preparation of the twelfth, 1865, the thirteenth, 1870, and the fourteenth, 1877, editions of the United States Dispensatory, a leading work on materia medica and pharmacy of such acknowledged excellence and accuracy as to be generally accepted as authority in the premises.

During the last few years of his life, Dr. Bridges endured most patiently the constant molestations and frequent pain which attend chronic cystitis. His repose at night, broken into a series of hourly naps, did not bring to him for the next day the refreshing effect of normal sleep; and so his physical vigor was continuously abated, and his mental pursuits greatly disturbed. But in spite of worry from this condition of his health, he was serenely cheerful and manifested his usual interest in scientific topics.

Within a few days of the completion of the seventy-sixth year of his age, he died, February 20, 1882, in the house he had occupied with his brother and family twenty-eight years.

He was never married. His generous and sympathetic kindness, self-sacrificing spirit and habitual amiability won the almost filial love and respect of his brother's many children. Their devotion to him is conclusive evidence of the excellence of his domestic qualities and the tenderness of his nature.

Frugal in his living, punctual and loyal to all duties, accurate, learned, unremittingly industrious, rigidly self-respecting and pure in conduct in every sense, he worked faithfully throughout his long life, but did not reap compensation commensurate with his toil. He lacked of that self-asserting, aggressive spirit which leads many a good man to fortune under circumstances in which one of far greater intrinsic worth often fails only because he is too shy, too modest to assert his claims to consideration. He was always content to leave to others the appraisement of his worth.

Without being ready in debate or at all eloquent in speech, he was an admirable and efficient teacher, as thousands of his pupils can testify. They will teach his lessons and thus long

continue and expand the beneficent influence of his instruction and example.

Though he was baptized in the Protestant Episcopal Church, and was occasionally present at its services, he seemed to hold views in harmony with the tenets of the Society of Friends, of which his mother and her ancestors were members. As long as the golden rule squared and regulated the daily practice of his life, the sunday observance of church ceremonies and listening to continuously iterated inculcations were insignificant, and, to our philosopher, seemingly without profit of any sort. The purpose of his life was to learn truths demonstrable to the senses. Of the kind of palpable truth, which is patent to the expert naturalist who perceives that the Creator is everywhere present in all His works, the church rector does not often speak; and if he did, could teach him nothing. To one earnestly engaged in the study of God's visible works, the attractions of pulpit teachings are comparatively feeble. To him doctrines and dogmas of every kind, though he may complacently listen to them, are of very small importance, because he knows that all doctrines and theories are unstable, and that the ascertained facts of the creation are permanent forever. He lived and believed as a christian, but without adhesion to any sect.

Dr. Bridges was notably reticent about himself among his most intimate friends. He left no letters or papers bearing testimony to his merits. A friend who had been intimate with him during a third of a century, says, in a letter, September 10, 1881: "Few men in this world—and I have met many who are good and generous—have ever, in my judgment, with such self-sacrificing generosity, bestowed as heartily their sympathy and their best efforts to gladden the lives of those around them, as our friend Bridges has always done. And the quiet, earnest and unflagging way in which he has bestowed the best energies and all the small rewards of his life among his friends is beautiful to behold. * * * *

"I am quite surprised to hear that he is able and enjoys so much exercise as to go twice a day to the cool hall of the

Academy to read in the library. I am very glad of it, and, especially, as he will there have the benefit of the refreshing atmosphere of that large room; and will enjoy the very best thing for him, not infrequent meeting with old acquaintances, and always find most congenial topics of conversation. I never shall forget the force with which, before I was well acquainted with Dr. Bridges, an assertion of Leidy one day struck me. Leidy said, he thought he had as much broad and general knowledge and accurate learning as could be found among us, and that he was a man of most sound and solid judgment. This I have found to grow upon my convictions of his mind and acquirements for the period of thirty-three years since Leidy spoke of him so sincerely and soundly."

His knowledge of natural history in general was extensive, accurate and always at command. He was a well-informed botanist, thoroughly versed in materia medica and chemistry, and a skillful practitioner of medicine. Naturally modest, almost shy, his manner to strangers was somewhat reserved, but cordial with his friends, all of whom regarded him with affectionate respect, because they recognized his perfect integrity, sincerity, extensive learning and good sense.

In the annual oration before the Alumni Association of the Philadelphia College of Pharmacy, March 13th, 1882, Mr. Frederick B. Power, spoke of him, as follows:

"I cannot refrain from adding my tribute to the memory of him whose loss we have so recently been called upon to mourn —the late Professor Dr. Robert Bridges. His faithful teachings, during an unparalleled period of service of nearly forty years, will long be held in grateful remembrance by those who were permitted to listen to his instructions, while his generous and noble nature, so beautiful in its simplicity, so approachable and free from ostentation, had endowed him with attributes well worthy of emulation, and endeared him to his pupils by ties of affection which will be ever fondly cherished."

In his valedictory address to the graduates of the college, March 15th, 1882, Professor Samuel P. Sadtler said:

"The Philadelphia College of Pharmacy has just lost, in the

death of Professor Robert Bridges, her Emeritus Professor of Chemistry, one, who, while he added much to her present substantial reputation, will be remembered and revered by those who knew him, chiefly because of his eminently lovable and unselfish character, his devotion to duty, and his faithful labors for the institution with which he was so long and so honorably connected.

"If we, younger men, and especially you, young gentlemen, just about starting upon your life's career, will emulate these qualities of character, we may expect some day, when the curtain drops upon the drama of our life, to have it said of each of us, as it is now said of him, 'his was a noble life.'"

Addition to these just eulogies seems redundant. But truth suggests that the most tender and considerate of all the testimony of his worth should be recorded. The Philadelphia College of Pharmacy did not limit its manifestation of respect to memorial resolutions or laying flowers on his bier. Its sense of sympathy and regret was substantially expressed in a spontaneous act of pure generosity. It asked, as a privilege inuring to long and intimate fellowship, to be permitted to defray the expenses of his funeral and to pay to his heirs an extra quarter's salary of the emeritus professor. Such homage is rarely offered; and when offered is seldom declined, even by opulent people.

Stated Meeting, March 21, 1884.

Present, 6 members.

President, Mr. FRALEY, in the Chair.

An acceptance of membership was received from Prof. W. LeConte Stevens, dated the Packer Collegiate Institute, Brooklyn, New York, March 11.

Acknowledgments of the receipt of Proceedings were received from the Museum of Comparative Zoölogy (114);

W. L. Stevens (114); U. S. Naval Institute (114); Leander McCormick Observatory (114); Cincinnati Observatory (114); Dr. Robert Peter (114), the Chicago Historical Society (114); the Wisconsin State Historical Society; the Christiania University (112); the K. L. C. Deutschen Akademie at Halle (108, 110, 111, 112; wants 109), and the Natural Historical Society, Northumberland, &c. (XVI i, 114).

Letters of envoy were received from the K. L. C. D. Akademie, November 3, 1883; Prof. W. L. Stevens; the Proprietors of Locks and Canals on the Merrimac river; James B. Francis, of Lowell, Massachusetts (wants 75, 96); the Department of Internal Affairs of Harrisburg, Pennsylvania; and the Cincinnati Observatory.

Donations for the Library were received from the Egyptian Institute; the Society at Stuttgard; the Revista Euskara; Revue Politique, Geographical Societies of Paris and Bordeaux; J. A. K. Newlands and J. Hambden, of London; the R. G. S. Cornwall; Canadian Record; J. B. Francis, of Lowell; American Chemical Society; American Bookseller; W. L. Stevens; H. Phillips, Jr.; Second Geological Survey of Pennsylvania; U. S. Bureau of Education; T. Gill; American Chemical Journal; American Journal of Philology; University of Cincinnati; C. Whittlesey; Chicago Historical Society; A. T. Andreas, and the A. A. A. S.

The death of Dr. Alfred L. Elwyn, at Philadelphia, March 15, aged 80, was announced by Mr. J. S. Price, and, on motion, the President was authorized to appoint a suitable person to prepare an obituary notice of the deceased.

The Librarian reported that he had received from Dr. Brinton the trunk of documents mentioned in the minutes of April 6, 1883, and requested orders respecting its disposal.

Pending nominations Nos. 1011 to 1015, and new nominations Nos. 1016 to 1022, were read.

An obituary notice of Strickland Kneass, by Mr. Fred. Graeff, was read by the Secretary.

A communication was received from Prof. Claypole, of Oberlin, Ohio, entitled, "On the Clinton and other Shales,

&c., composing the Fifth Group of Rogers, in the First Survey of Pennsylvania."

The amendment of the Rules was referred to the consideration of the President.

The Committee on Aztec MSS. reported progress.

The Committee on the Michaux Legacy reported as follows:

That under last year's authority of the Society, the sum appropriated was expended in the delivery of fourteen lectures in the Fairmount Park, during last year, according to annexed schedule, to increased and interested audiences.

The Committee recommend that the like appropriation be made for the present year, of two hundred and eighty dollars, for fourteen lectures, according to schedule annexed, and fifty dollars for advertising.

Free Lectures in Fairmount Park on Botany and Tree Culture, by Prof. J. T. Rothrock, on Saturdays, at 4 P. M., 1884.

April 19. Relation of American forests to American prosperity.
26. Plant freaks.
May 3. Insects and plants.
10. Insects and plants.
17. How timber matures, how it decays and how to use it.
24. Natural selection as related to increase of plants.
31. What evolution has done for science and for education, and where its possibilities stop.
Sept. 6. Plants in literature and in superstition.
13. Plant life during winter.
20. Stray plants.
27. Bread plants.
Oct. 4. Water plants.
11. A talk about trees.
18. The extinct plants of our land.

Mr. Fraley announced that he would send to the Society an original copy of the draft of the agreement proposed to be executed between the City and the Society when the latter

entered into the tenancy of the building. It recites the status between the City and the Society, which has lasted until now.

Stated Meeting, April 5, 1884.

Present, 10 members.

President, Mr. FRALEY, in the Chair.

Letters of acknowledgment were received from the Peabody Institute, Baltimore (110, 111, 113), the U. S. Surgeon General's office (114), and the Society at Winnipeg (114).

A letter of envoy was received from Dr. A. C. Fryer, dated Elmhurst, Wilmilon, Cheshire, England, March 10.

A circular letter from the Accademia dei Lincei, announced the death of its President, Sig. Quintino Sella.

Donations for the Library were received from the Academies, Societies and Observatories, at St. Petersburg, Moscow, Vienna, Berlin, Halle, Marburg, Turin, Bordeaux, Liverpool and Winnipeg; from the Swedish Statistical Bureau; from the Ethnological and Geographical Societies; the Museum of Natural History and Revue Politique, Paris; from the Royal Institution, Astronomical, Geographical, Asiatic and Geological Societies, A. C. Fryer and Nature; James Freeman Clarke, of Boston; James Hall, of Albany; the Rhode Island Historical Society; American Journal of Science; the New Jersey Geological Survey; the American Journal of the Medical Sciences; Academy of Natural Sciences; Franklin Institute; Dr. H. C. Chapman; Prof. Wm. Dennis Marks; H. Phillips, Jr.; the Johns Hopkins University; U. S. Fish Commission; Washington Philosophical Society; and the Illinois State Museum of Natural History.

Dr. John Curwen, of Warren, Pennsylvania, accepted the appointment to prepare an obituary notice of the late Dr. Kirkbride.

Mr. Lesley read Mr. J. F. Carll's correction of a wrong hori-

zon assigned to a specimen of *Eurypterus pennsylvanicus*, found 72′ + top of Pithole well, Venango county, Pennsylvania, which places it 167′ above top of Pithole (Berea) grit struck in the well; therefore, a considerable distance *beneath* the Garland or Olean (Pottsville conglomerate bottom member) conglomerate. In Proceedings American Philosophical Society, Vol. XVI, page 621, its horizon is wrongly made to be *above* the Garland conglomerate, and therefore in the Pottsville conglomerate No. XII. Mr. Lesley remarked that Prof. James Hall's description of this and other Eurypterids, beautifully drawn by Mr. Simpson of Albany, was about to be published in Report of Progress, P. 3, of the Second Geological Survey of Pennsylvania.

Mr. Blazius read a paper on the unhealthy conditions of certain portions of great cities, produced by prevalent winds from certain quarters, and on the necessity for providing for their inhabitants means of rapid transit to and from the surrounding country.

Pending nominations Nos. 1012 to 1022, were read.

And the meeting was adjourned.

Obituary Notice of Strickland Kneass. By Frederic Graff.

(Read before the American Philosophical Society, March 21, 1884.)

On the morning of January 14, 1884, one of the valued members of this Society, Mr. Strickland Kneass, died at his residence in this his native city. We realize with sincere regret the loss of one intimately identified with the local affairs of this city, and the valuable railroad interests of the State connected therewith, and present this brief sketch of his life, as a record of a worthy and useful man.

Mr. Kneass was born July 29, 1821. His father, Mr. William Kneass, was an engraver of some note, and for several years employed in that capacity by the Government in the Mint in this city.

Mr. Kneass obtained his early education under the care of Mr. James P. Espy, who was one of the first to devise and suggest the present methods of anticipating changes in the weather, though from the lack of telegraphic communication at that time they fell short of the completeness that they have since attained.

After leaving school Mr. Kneass decided to adopt the profession of Civil

Engineer, and an opportunity soon offered for the commencement of his practical training as such, under the care of his elder brother, Mr. Samuel H. Kneass, assisting in the surveys then making for the Delaware and Schuylkill Canal, and later took part in the surveys and construction of the Philadelphia and Wilmington Railroad.

Upon completion of this road, wishing to become grounded in the scientific part of engineering, he became a student in the Rensselaer Polytechnic Institute, at Troy, New York, whence he graduated, in 1839, as Civil Engineer, taking the highest honor.

Soon after this Mr. Kneass was made assistant engineer and topographer on the State survey for a railway between Harrisburg and Pittsburgh; he then became draughtsman in the Naval Bureau of Engineering at Washington, and was afterward employed by the British Commission in preparing the maps of the northern boundary, between the United States and the Provinces; and subsequently, by the Federal Government on the general map of the boundary survey.

At a later date, 1869, he was appointed, jointly with Colonel James Worrall, a commissioner to settle the boundary between Pennsylvania and Delaware. The location of this line permanently and correctly (an arc of a circle of about twelve miles radius) required great care, for the accomplishment of which Mr. Kneass's remarkable thoroughness peculiarly fitted him. The proposed line was not accepted by the Delaware commission.

In 1847, Mr. J. Edgar Thomson, Chief Engineer, selected Mr. Kneass as one of his assistants in conducting the preliminary surveys, which resulted in the construction of the Pennsylvania Railroad. He was soon promoted to the position of Principal Assistant Engineer, and engaged in the construction of that part of the road from "Jack's Narrows" to Tyrone, including nine bridges and Tussy Mountain tunnel.

Under his supervision, and from his designs, the first shops and engine house at Altoona was erected.

The construction of the road from Altoona to the summit of the Alleghenies was a work of much difficulty, and called forth engineering ability of a very superior order, in the accomplishment of which Mr. Kneass proved himself fully capable. We must remember that at that time none but hand-drills were used in rock excavation and tunneling, and no high explosives or steam excavators employed.

In 1853, he resigned to accept the position of associate engineer with Mr. Edward Miller, Chief Engineer of the North Pennsylvania Railroad, in which capacity he remained two years, leaving to accept the office of Chief Engineer and Surveyor of the consolidated City of Philadelphia, to which position he was elected by Select and Common Councils, March 29, 1855, and subsequently re-elected three times, namely, April 12, 1860; April 12, 1865, and April 14, 1870, each for a term of five years.

Mr. Kneass's services in the Department of Surveys were of great value. The City proper and the seven adjoining Districts were, up to 1855, en-

tirely distinct and separate corporations, each having its own boards, officers, surveyors and engineers, working without any concert of action, or connected fixed plans either of grades, standard of measures, or designs of sewerage. Even the records of the old Districts were deposited indiscriminately in a City warehouse, and had to be collected, arranged and classified.

It therefore became necessary to establish a general plan of grades, sewers, &c., &c., that would combine as far as possible the disjointed work previously done. To this task Mr. Kneass applied himself with all his energy, engineering knowledge, experience and capacity for classification.

Maps were made of the whole area of the consolidated City, from which the grades were adjusted, the drainage areas carefully computed, and a standard of size for sewers established, that was intended to be useful not only for the sewers built whilst he was in office, but which amply provided for the entire future drainage system of the City.

Up to 1865, there was no record or plan by which the ownership or dimensions of an individual property could be ascertained. Under an Act of Assembly, passed March, 1865, Mr. Kneass organized and put into successful operation, what is known as the Registry Bureau. By an exceedingly simple system of plans, and records, arranged in book form, the information in regard to any individual property can be obtained in a very few minutes. The record is of very great value and importance to the general public, and exceedingly useful in getting data for an equal assessment of taxes, to effect which object the Act of Assembly was mainly intended.

The method devised and employed has since been adopted by other cities, without any attempt to improve upon it.

During Mr. Kneass's term of office several very important bridges were required to be built across the Schuylkill at various points, the first and most important being at Chestnut street.

In 1857, Councils advertised for designs for a bridge at that street, and appointed a Commission, consisting of J. Edgar Thomson, Ashbel Welch, and John C. Cresson, to decide upon the merits of the designs, which were all presented anonymously, being simply distinguished by the private marks of the designers.

Mr. Kneass considered it his duty to present a plan, and did so in the manner described above. This plan was fully approved by the Commission, and recommended to Councils for adoption.

The design was for the cast iron-arch bridge, essentially as erected, except in respect to the width of roadway, and length of the approaches; in regard to which the suggestions, and first plans of the engineer and surveyor were not adopted by Councils, because of the increased expense, a matter much to be regretted, now that the traffic has increased so much beyond that anticipated by Councils, but foreseen by Mr. Kneass.

This is believed to have been the first cast-iron arch bridge constructed in this country.

The location of the bridge, and particularly its western abutment and approaches, presented some difficulties of construction, but were believed to have been fully guarded, and at the time considered by the board of commissioners and all connected with the work as ample to insure its permanency.

In 1866, a commission was appointed by an Act of Assembly to build a bridge across the Schuylkill at South street, under the general supervision of Mr. Kneass, as Chief Engineer and Surveyor. The plans received from a number of bridge builders were referred by the commission to Mr. Kneass, who reported upon their relative merits, and recommended that submitted by John W. Murphy, with certain important modifications; among them the substitution of iron girders and cast-iron piers for the stone and brick arches over the marsh on the west side of the river. These suggestions were at first fully approved by the commission, but by subsequent action his advice was neglected, and the erection of the brick arches which he had condemned, and which have since failed, show their error in not being guided by the Chief Engineer and Surveyor.

In April, 1869, under direction of Councils, plans of a bridge were called for at Powelton avenue, or Bridge street. Mr. Kneass recommended the site of the old wire suspension bridge at Callowhill street, and a double roadway truss bridge. The general plans for such a structure were approved October, 1868, but owing to the tardy action of Councils in authorizing a loan, and making the appropriation, the contracts for the bridge were not fully entered into, and the work commenced, until after he had resigned his position; but the original designs were fully carried out by his successor.

During the war, in 1862, in company with the late Colonel C. M. Eakin, he was engaged in making reconnoissance of the military approaches to the city, extending along the Susquehanna river, from Duncan's Island to Havre de Grace. The work in the field and accompanying maps were highly useful at the time of Lee's last raid into Pennsylvania. This report, with the maps, are now deposited in the office of the Department of Surveys.

Mr. Kneass built the first street passenger road (the Fifth and Sixth or Frankford and Southwark) put in operation in this city, and then devised and established the form of tram rail, now used on all similar roads in this country. He subsequently acted as chief engineer of a number of the passenger roads of the city.

In 1871, Mr. Kneass was selected as one of two engineers to make a survey, and report upon the best means of draining or culverting Jones Falls, Baltimore, Md.

During Mr. Kneass term of office he was officially one of the Board of Commissioners of Fairmount Park, and rendered essential service in that capacity; his knowledge of the ground covered by the Park and its surroundings being very useful.

April 12, 1872, Mr. Kneass resigned his position as Chief Engineer and

Surveyor to accept the post of assistant to President J. Edgar Thomson, of the Pennsylvania Railroad, and subsequently occupied the same position under Thomas A. Scott, and Mr. George B. Roberts, the present President. In connection with this office he served as President of the following companies, viz.:

Belvidere and Delaware Railroad Co.
Columbia and Port Deposit Railroad Co.
Freehold and Jamesburg Agricultural Railroad Co.
Lewisburg and Tyrone Railroad Co.
Mifflin and Centre County Railroad Co.
Philadelphia and Trenton Railroad Co.
Pomeroy and Newark Railroad Co.
Philadelphia and Long Branch Railroad Co.
River Front Railroad Co.
New Jersey Warehouse and Guarantee Co.
Cressons Springs Company.

He was also a Director in forty-four of the companies identified with the Pennsylvania Railroad.

Mr. Kneass was a member of the American Philosophical Society, the Franklin Institute, the Historical Society, the American Society of Civil Engineers, and the Engineers' Club of Philadelphia, of which Club he was President during the year 1881.

He was one of the early members of the Union League, of this city, and one of its Board of Directors from December, 1879, to December, 1883.

Mr. Kneass was married, in 1853, to Margaretta Sybilla, granddaughter of the Hon. George Bryan, of the Supreme Court of Pennsylvania.

Mr. Kneass was a sincere Christian, a member of the Seventh Presbyterian Church; in 1856 was elected a member of its Board of Trustees; acting as Secretary until 1872, when he became President. His principles of honor were of the highest character, always just and impartial; as a public officer, most carefully guarding the interests of his employers, whilst at the same time he was mindful of the rights of employés. A warm and reliable friend, kind and generous, his sound judgment caused him to be looked up to by those requiring his advice. His manner was courteous to all, inspiring respect from those with whom he was associated.

Note on a possible Geographical Meaning for the Set Griffin. By J. P. Lesley.

(*Read before the American Philosophical Society, Jan. 4th, 1884.*)

This chimerical animal sits on his haunches, with ears and tail erect, his breast and fore legs being vertical; his back slopes at 45°, and the end of his vertical straight tail is on a level with his head, so that the whole figure resembles a capital Roman letter N.

There is nothing peculiar about the animal except his ears and tail. He is evidently a jackal, fox or dog. But his ears are very long, stiff and straight in the air, diverging; and his rod-like tail is *forked* at the end. He is usually called a *griffin;* by some a *giraffe.*

Set was the genius of destruction and mischief, in some radical way connected with the sea, and I believe was the demon of the Red sea He was the demon of the desert also. The Red sea is the sea of the desert lying between the Lybian and Arabian deserts. Egyptologists are familiar with the varying history of the religious worship of this deity, its opposition to the systems of Nile worship and Osiris worship, and its later fusion with the Sutech-Baal worship of the Syrian immigrants.

I wish to point out a plausible geographical explanation of the original idea of Set, derived from the shape of his ideograph.

In hieroglyphic inscriptions running from left to right, the animal sits facing the west, his back slopes south-east, and his ears are often portrayed not only diverging but pointing a little forward, a little west of the vertical. I fancy that a representation of the Red sea, with its two gulfs of Suez and Akabah, was intended; and that its tail was meant to represent the Persian gulf, *forked* to represent the Euphrates and Tigris rivers.

A forked vertical tail to an animal so simply constructed in the ordinary shape of a jackal was certainly a most extraordinary freak of fancy, if there lay no hidden meaning behind the design. It cannot be objected that the old Egyptians were not good geographers. The orientation of the pyramids in the fourth dynasty, and the expedition of Hannu to Punt, in the 11th or first Theban dynasty, are in evidence to the contrary. But it is a question how early the Egyptians knew Mesopotamia or Chaldæ well enough to represent its two rivers (the rivals of their Nile) by the fork of a tail to their ocean deity, or otherwise. The god Set appears to have been worshiped by the mother of the builder of the first pyramid. The campaign of Kedarlaomer was a comparatively late event, probably subsequent to the 12th dynasty; but it suggests similar movements on a less heroic scale in much earlier days; and no one has yet made out the direction from which the pyramid builders came to take possession of Egypt. It is evident that they introduced a foreign Ra, and Hor worship; but whether they brought with them Hathor and Set, or found them in Egypt is not known.

I think the Ata-Teta-nomenclature of the very first dynasty is good evidence that the pre-pyramid rulers had come from Yemen; but the pyramid builders would more likely come in from Syria, and stop at Memphis. If so, they would undoubtedly be familiar to someextent with Mesopotamia, if only through wandering merchants, or, if there were none such, through that transmission of information from region to region which has characterized all ages.

Stated Meeting, April 18, 1884.

Present, 12 members.

President, Mr. FRALEY, in the Chair.

Mr. Vaux was introduced and took his seat.

Letters of acknowledgment were read from the Vienna Central Institute for Meteorology (113), Royal Danish Society (112), Yale College (114), Vassar Bros. Institute (114), Maryland Historical Society (114), and the Franklin Institute (duplicate numbers of their Journal).

Donations for the Library were received from the Egyptian Institute; the Geological Survey of India; the Imperial Botanical Garden, St. Petersburg; the Royal Academy, Bruxelles; R. Accademia dei Lincei, Archives of the Chamber of Deputies, Rome; Society of Natural Sciences, at Pisa; Société de Geographie, Annales des Mines, and Revue Politique; Société de Géographia Commerciale; Journal of Forestry and London Nature; Robert Atkinson, LL.D., Dublin; Canadian Institute; Boston Society of Natural History; American Journal of Pharmacy, Engineers' Club, A. E. Foote, Persifor Frazer and Henry Phillips, Jr., Philadelphia; Johns Hopkins University; U. S. Naval Institute; U. S. Department of the Interior; Chicago Historical Society, American Antiquarian, and William Bross, of Chicago.

A letter from Mr. William Brooke Rawle, Secretary of the Historical Society of Pennsylvania, to the President of the American Philosophical Society, dated April 17, 1884, was read, explaining the delay in returning the Penn and Logan Correspondence MS., loaned to the Historical Society April 18, 1879, and requesting permission to keep them a short time longer for the copyist. On motion, the request was granted.

Mr. Phillips having prepared a Register of written communications printed in the Proceedings of the American Philosophical Society, Vols. I to XX, inclusive, it was, on motion, ordered to be printed.

PROC. AMER. PHILOS. SOC. XXI. 115. 3F. PRINTED MAY 12, 1884.

"Photodynamic Notes, No. IX," was communicated by P. E. Chase.

Extracts from a report on the Hams Fork coals of Wyoming Territory, by P. W. Sheafer, were read by the Secretary.

Mr. Lesley exhibited a model of the Nittany valley and Bald Eagle mountain, east of Tyrone City, Pa., made by Mr. E. B. Harden, from his own surveys.

Also a model of the Jones' iron ore mine in Berks county, by J. H. and E. B. Harden, after their own surveys.

Dr. T. S. Hunt gave an account of his examination of this and other like iron ore mines in Pennsylvania, assigning them all to the horizon of Prof. H. D. Rogers' Primal slates, although they lie in immediate contact with the Triassic rocks.

Dr. Frazer described the ambiguity of data respecting their true horizon, with facts to prove that while some of the mines (as at Dillsburg in York county) penetrate the Trias, these may be merely the redeposited detritus of more extensive Primal Slate iron ores.

The President, to whom the resolution on a change in the Order of Business Rules had been referred, reported an emendation of it, which was laid on the table for consideration at the next meeting.

New members elected:—

Richard L. Ashhurst, of Philadelphia.
Samuel Dickinson, of Philadelphia.
Rev. Joseph F. Garrison, M.D., of Camden, N. J.
John R. Baker, of Philadelphia.
Prof. Edmund J. James, of the University of Pennsylvania
Wharton Barker, of Philadelphia.
James H. Hutchinson, M.D., of Philadelphia.
Francis Jordan, Jr., of Philadelphia.
Herbert Welsh, of Philadelphia.
Prof. Henry S. Frieze, of the University of Michigan.
Francis Wharton, LL.D., of Philadelphia.

The Course and Growth of the Fibro-Vascular Bundles in Palms. By John Casper Branner, B. S.

(*Read before the American Philosophical Society, October 19, 1883.*)

The classification of phænogamous plants as endogens and exogens was based upon the theory of the supposed course and development of the fibro-vascular bundles in the stem of the palm. That a question of so much importance botanically has received no more careful attention, is probably due to the fact that the original theory of endogenous growth was considered so simple, satisfactory, and self-evident from a transection of a palm trunk, that its very simplicity was an impediment to investigation.

Comparatively few botanists have given especial attention to the subject of the structure of the palm stem, and those who have done so, have encountered so many difficulties in obtaining proper material,* and in getting satisfactory results from material to be had, that our certain knowledge upon the origin and course of the fibro-vascular bundles is still confused, and the theories and explanations of growth unsatisfactory and even perplexing. The best observers failed to grasp the whole subject, while others have given us masses of useless, irrelevant, and erroneous matter with only here and there a useful fact. From such results it is so difficult to select that which is useful, that it is simpler to leave the whole to one side and do the work all over from the beginning.

The difficulty, almost impossibility, of tracing the course of the fibro-vascular bundles in the hard, complex palm stem, has added not a little to the uncertainty and doubt that every one has felt who has advanced a theory of growth, or tried to prove their direction by actual dissection.

The peculiar structure of the trunk of the palm was mentioned about 300 B. C., by Theophrastus in his Historia Plantarum, Bk. I., Chap. IX. In the sixteenth century, Rumphius, French Consul on the Dutch Island of Amboyna, called attention to the same point, and in the seventeenth century his observations were confirmed by those of P. Labat, in the West Indies, and also by those of Desfontaines, made in Tunis and Algiers.

As a botanical question it may be said to have been opened by Desfontaines, member of the French Academy of Sciences, who, while he propounded a theory, personally took very little part in the discussion he had raised.† A general statement of his theory given by Mirbel‡ is sufficient for present purposes. In the "Fragment d'un voyage dans les Régences de Tunis et d'Alger, fait de 1783 à 1786," p. 290, Desfontaines says: "La

* Mirbel went to Africa to study the structure of the date palm, but even there found it almost impossible to obtain a grown one, and was about to abandon his work when a gentleman gave him a specimen.

† His views were published in the "Mémoires de l'Institut National," Vol I., 1798, pp. 478–502.

‡ Comptes Rendus de l'Académie des Sciences, 1843, Vol. I., June 12.

moelle des Dattiers est placées dans l'interval des fibres qui vont toujours en se serrant du centre à la circonférence, en sens contraire des autres arbres, et elles ne sont pas placées par couches comme j'ai en mille fois l'occasion de l'observer sur des troncs coupées."

Although Desfontaines kept comparatively quiet upon the subject, pupils of his, and especially Daubenton, took up his theory, and did all in their power to give it general acceptance in the scientific world. We know how successful they were, for, in 1819, de Candolle published the classification in which all phænogamous plants were divided into endogens and exogens. This classification was based upon the theory of Desfontaines, and, after its publication, was accepted without question of importance up to 1824, when Hugo von Mohl published his "De Structura Palmarum." Previous to Von Mohl, however, Moldenhawer had denied the theory of Desfontaines. As stated by Mirbel,* this theory of Moldenhawer was, that the fibro vascular bundles in monocotyledons take the place of the woody layer in dicotyledons, and that the lignification begins at the centre, and gradually approaches the circumference. If Mirbel's be a true statement of Moldenhawer's theory, I see no reason for considering it of much importance, as it was only proposing to replace one error by another.

The next work upon palm structure is that of Hugo von Mohl, published in 1824, as an introduction to Dr. C. F. P. von Martius' "Genera et Species Palmarum."† Von Mohl's work was done so carefully and conscientiously that although his theories have been attacked, and more or less modified by Meneghini and Mirbel, they have been generally and justly accepted as the best, if not the true ones, up to the present time. And, however much one may disagree with Von Mohl's conclusions, he cannot help feeling that his work would have been more thorough and more satisfactory if he had had more extended opportunities for observation. He admits that he had only young specimens, and portions of full-grown palms to work upon,‡ and any one who has tried to investigate this subject, can appreciate the difficulty or impossibility of demonstrating anything satisfactorily in a short section of a mature trunk, and may well wonder that Von Mohl came so near the truth with such unsatisfactory material from which to gather his facts and draw his conclusions. Writers upon palm structure are continually referring to the difficulty of dissection and investigation, and in the literature of the subject we find them admitting their inability to make out certain points§ on account of the impossibility of following the bundles.

Next after Von Mohl came Meneghini in his "Recherche sulla Struttura," etc.,‖ published in 1836, and followed in 1843 by more recent observations, under the title of "Intorno alla Struttura," etc.‖

*Comptes Rendus de l'Acad. des Sci., 1843, Vol. I., p. 1216.
†See under Von Mohl in literature at end.
‡V. Ray Society, 1849, pp. 73-77.
§Ray Society, 1849, p. 85.
‖V. literature at end, under Meneghini.

In 1839 the French Academy of Sciences sent out one of its members, M. C. F. B. Mirbel, to Africa for the purpose of investigating the structure and manner of development of the date palm, and in 1843 the results of Mirbel's work were given to the Academy.* The following year Mirbel contributed a paper on the structure of *Dracæna australis*, in which he also referred to the question of palm structure.† Contributions to the subject were made by Lestiboudois‡ in 1840, and by Unger§ in the same year.

In 1845 Dr. C. F. P. Von Martius gave a statement of his theories upon the subject.‖ Sachs, in his text-book¶ refers to Nägeli,** and Millardet** as authorities upon the direction of the fibro-vascular bundles, but there is nothing in his own explanations to lead one to suppose that these writers differed materially from Von Mohl.

These are the names of the principal contributors to the literature, and since Von Mohl published his appendix in reply to Mirbel and Meneghini in 1845, it will be seen that little or nothing has been done in the way of original investigation.††

I will now briefly restate the theories held by the principal investigators in regard to the more important characters of palm structure.

First, we have the theory of Desfontaines, Daubenton and de Candolle, which prevailed up to 1824, and which has scarcely yet been completely eradicated from text-books on botany.‡‡ This was the theory of endogenous or inward growth. It held that the inner fibro-vascular bundles in a palm trunk ran to the new fronds, and the outer ones to the old. This theory was probably largely due to the fact, that in a transection of a palm trunk the outer bundles are hard and bony, while the inner ones are tender, and generally of a lighter color. Considering the state of botanical knowledge at the time this theory originated, it was perhaps a natural conclusion to draw from so limited an investigation of the subject. A hemisection of a palm trunk, as they understood it, would be represented diagrammatically by fig. I., and a transection by fig. II. Fig. II. has the fibro-vascular bundles displayed just as we find them in fact, the softer and lighter-colored ones through the centre, and the hard bony ones next the periphery. This crowded condition of the outer bundles was supposed to be the result of the growth of the new bundles at the top of the trunk, which pressed

* Comptes Rendus de l'Acad., 1843, Vol. I., p. 1213.

† Comptes Rendus de l'Acad., 1844, Vol. II., p. 689.

‡ "Études sur l'Anatomie et le Physiologie des Végétaux."

§ "Ueber den Bau und das Wachstum des Dicotyledonstammes," 1840, p. 35.

‖ Comptes Rendus de l'Acad., 1845, Vol. I., p. 1033.

¶ Oxford ed., 1875, p. 552.

** V. literature at end.

†† Dr. Gray refers (Text-Book, 6th ed., 1879, p. 71, foot note) to a memoir of recent date by Guilland: "Recherches sur l'Anatomie Comparée et le Developpement des Tissus de la Tige dans les Monocotyledones." Ann. Sci. Nat., Ser. 6, V., 1–176, 1877. I have not seen this work.

‡‡ Dr. Gray says that the word "endogenous" is still retained for the purpose of indicating a peculiar stem structure.

them out, and packed them closely together. This was also supposed to account for the even size of palm trunks.

The theory of Von Mohl, based upon careful study, completely overthrew the theory of Desfontaines. His investigations showed too that the structure of the palm trunk was no such simple matter as had been supposed. The leading features of Von Mohl's theory are as follows: Dissecting out a fibro vascular bundle from the base of a frond, it curves in to the centre of the stem, and downwards, and after a short course through the centre of the trunk gradually approaches the periphery, and then runs down into the base. Later Von Mohl modified this statement, recognizing the fact that his investigations had been made upon too young specimens, and that in a full grown stem the bundles did not reach the base * He then concluded that their lower extremities ended blindly on the periphery, and that at their upper ends they grew into the phylophore.† He observed their difference of structure in different parts, their varying size, their hardening, coloring, the slight growth in size of the bundles blending, and, after it was called to his mind by Meneghini, recognized their spiral direction (though he attached no importance to it‡), and that the course of the fibro-vascular bundles was the same in all palms.

Meneghini laid stress upon the oblique course of the bundles, and explained it as a mechanical result of unequal growth of stem and frond scars. He supposed the trunk to outgrow the leaf so much that the base of the frond was thrown out of its former relation to the other fronds, and that the bundles were thus drawn to one side, causing this obliquity in their direction. The occurrence of fronds at the same angle to each other on the stem was accounted for in the following manner: In the apex, as he believed, the fronds were arranged in a helix, which, in the course of growth, became a spiral line upon the stem, the fronds all having been drawn aside equally. He also advanced a theory of the creation of the fibro-vascular bundles by currents of sap in the phylophore, and thought they were to "be regarded as descending from the nascent leaf in the centre of the bud." §

*Duchartre, in his "Éléments de Botanique," p. 179, gives Von Mohl's theory in its original form, and in a figure represents the fibro-vascular bundles as all running into the base.

† There has been no little misunderstanding of Von Mohl's theory and descriptions. Mirbel did not know whether he meant that the bundles grew downwards from the bases of the fronds (Comptes Rendus, 1843, p. 1218, *et seq.*). In stating Von Mohl's theory, he says that "selon M. Mohl, les filets * * * * * partent des feuilles," and a little further on he declares that he does not know what Von Mohl means by saying that "les filets partent des feuilles et descendent vers la base."

Duchartre in his "Éléments de Botanique," p. 177, in explaining Von Mohl's theory, says of a fibro-vascular bundle: "Il descend verticalement sur une certaine longueur."

‡ Duchartre has credited Von Mohl with the discovery of the spiral direction of the bundles ("Éléments de Botanique," p. 177), but Von Mohl confesses that he laid no stress upon it, leaving us to infer that he had observed it. Ray Society, 1849, p. 52, third line from bottom.

§ Ray Society, 1849, p. 90.

Mirbel stated that the fibro-vascular bundle originated in a utricle at the periphery of the phylophore, and grew upwards into it, whence it curved outwards and entered a frond base on the side opposite the one upon which it originated.* "Le plus grand nombre, si n'est pas la totalité, nait à la surface interne du phylophore * * * * une partie d'entre eux s'allongent et monte à peu de distance de cette surface, puis se courbe tout à coup vers la périphérie et va joindre la base des feuilles, qui elles rencontre *chemin faisant.*" He believed the number of bundles in a stem might increase indefinitely, and in this way he accounts for the spindle-shaped trunks of certain palms.

Gaudichaud's theory was, that the bundles all originated at the frond bases† in the phylophore, and grew downwards to the base, and out to the ends of the roots. Says M. Gaudichaud :‡ "M. Mirbel soutent que c'est de bas en haut qu'elle agit ; moi je prouve par des faits, par tous ceux que j'ai observés que c'est de haut en bas, des bourgeons aux racines * * * Ils marchent donc !"

At the close of the reading of his seventh and last paper on this subject before the French Academy, he says, that whatever the Academy may think about the matter "il ne me restera plus qu'à m'écrire, moi aussi : Et pourtant ils descendent !"§

Dr. Von Martius stated,‖ that all fibro-vascular bundles connected with fronds ; that they originated in the phylophore, exterior to and below the others ; that the points of origin were organic ; and that they grew upwards and downwards. He believed the bundles to end blindly below in the periphery, and that they might come to the surface above, either on the same side of the stem, or on the side opposite.

It is not my purpose to offer just here the objections that might be raised to the theories of these different authorities, but to present the result of my own observations in order, and to point out wherein they differ materially from those of others.

A transection of a full-grown palm trunk shows a number of hard fibro-vascular bundles scattered through it, without any further arrangement than that they are more numerous, harder, and generally colored near the circumference, while the parenchymous or pithy part prevails in the centre. A hemisection from base to apex shows (Figs. III, IV,) that the bundles have, for the most part, the appearance of being parallel, while at short intervals a few of them are seen to curve out from the centre of the stem to the fronds, or to the spadices growing in the axes of the fronds, or in case both spadices and fronds have fallen, to their old scars.

In trying to trace any one of these bundles, we find that it, sooner or

* Comptes Rendus de l'Acad., 1844, Vol. II., p. 630.
† Comptes Rendus de l'Acad., 1845, Vol. II., p. 284.
‡ Loc. cit.
§ Loc. cit., p. 272.
‖ Comptes Rendus de l'Acad., 1845, Vol. II., p. 1038.

later, becomes entangled in the mass, or that it has been cut across in making the section. With a hard stem this is invariably the result, but if the stem be a decayed one, in which the cellular tissue has disintegrated and left the bundles more or less free, the direction of a bundle may be followed with more or less certainty. Beginning with one of these where it curves inward and downward from the base of a frond, it may be traced inward to or near the centre, then downward, gradually approaching the circumference again. In this lower part of the bundle, however, the angle of divergence from a parallel with axis and periphery is so small in most palms, and the little curves made by the bundle in crossing others so misleading and confusing, that it is with some difficulty one can appreciate the fact that the bundles are not all parallel to each other and to the axis of the stem. If, however, the internodes are short, and the trunk is comparatively large, we may expect to find this angle more defined. This is very marked in the rhizomes of the so called trunkless palms* upon which the fronds are crowded in the shortest possible length of trunk. In these rhizomes this direction of the lower extremity of a division of a fibro-vascular bundle is visible at a glance. On approaching the periphery of the trunk the bundle is found to decrease in size, and finally it breaks off and appears to end blindly in the mass of other bundles near the surface. As far as can be made out then, in a full grown stem, by this method of dissection, this is what we find the course of the fibro-vascular bundles to be: from the base of the frond they curve sharply inwards to the centre, and then gradually outward to the surface, and there end. If it were possible to take up the bundles in any part of a stem, and follow them *upwards*, one after another, it would be found that they all connect, sooner or later, with fronds or spadices† (or their scars), and that none of them end blindly on the internodes.‡

So far I have spoken of tracing a bundle downward from the insertion of the frond. To this method of dissection is largely due the uncertainty about the lower extremity of a division. By examining the apex, or growing part of the trunk, it may be seen that these bundles do not end blindly at their lower extremities upon the surface of the stem, but that they are connected in sections or divisions§ from the base to the apex, one with another, and one on top of another.

* In classifying palm stems according to their structure, Von Mohl made a sub-division of the rhizomes of trunkless palms, but made no investigation of them on account of lack of material. V. Ray Soc., 1849, pp. 6-7.

† Dr. Von Martius does not mention bundles connecting with spadices.

‡ In his "Text-book on Botany" (Ed. of 1879), Dr. Gray gives a figure of a palm trunk which represents the fibro-vascular bundles coming to the surface very much at random, and bending outward all through the stem. This is not what is seen in a palm stem, especially if the internodes are of any considerable length, but the bundles turn out to the fronds or scars *only*, and never to internodes.

§ I have spoken of the parts of a bundle between the points of branching as *divisions*.

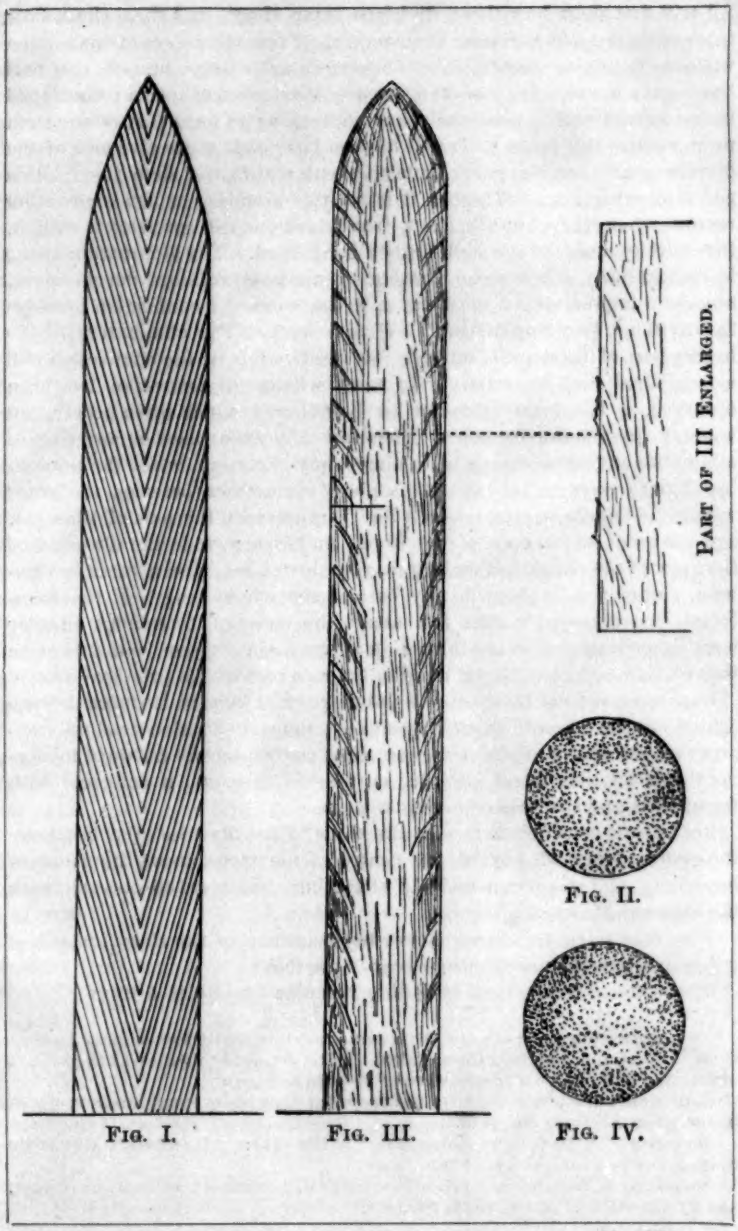


Fig. I. Fig. III. Fig. II. Fig. IV.

PROC. AMER. PHILOS. SOC. XXI. 115. 3G. PRINTED MAY 12, 1884.

I will first show how these divisions came about, and then show how this effects the whole system of structure. From the points of connection with the fronds or spadices, the fibro-vascular bundles branch, one part having the immediate external growth (either frond or spadix), developed in connection with it, and the other continuing to form part of the stem proper above this point.* It will be seen later that these divisions of the bundles reach their greatest developement within the stem just at this point of branching. Whether it is on this account, or for some other reason, whenever a bundle has a frond developed in connection with it, the development of the stem branch is retarded. The attenuation of the lower extremity of a division, consequent upon this retarded development, renders it impossible, in most cases, to trace out the connection between the divisions, however carefully one may work. The elimination of the harder part of the bundle renders the observation of the connection still more difficult and uncertain.† In cases where this connection has been observed, it has been mistaken for blending, ‡ which often occurs, but which is quite another matter. Blending may take place in any part of a bundle's course, and may be in almost any direction, while the branching I here refer to, always takes place somewhere between the point where the bundle is tangent to a line parallel with the axis of the stem, and the point of insertion of the frond, and is always in the direction of the apex of the trunk. Blending may be upwards or downwards or sidewise, and may take place in any part of the whole length of the stem. It is often observable that just above the point of branching another bundle is developed on the inner side of the main division, but this piece is not continued as a distinct bundle, but as a part of the principal one.

Beginning then at the base of a palm trunk, a bundle is traceable into a frond, at the base of which it branches; the stem division gradually approaches the centre of the stem, and there curves sharply outward to connect with another frond, and so, curving in and out, it connects with frond scars and spadices from base to apex.

Let us now consider these two directions of the fibro-vascular bundles: the gradual approach toward the centre of the trunk above the point of branching, and the comparatively sharp curve outward to connect with the external growth.

Why does a bundle always return to the centre of the stem, instead of going in a straight line from one scar to another?

First: the development of a fibro-vascular bundle is always in the

*The connection between the divisions is seldom easily found, some species show it much more plainly than others. The specimens in which I have seen it most often and most distinctly were of *Raphia tædigera*.

†Von Mohl admits his inability to determine how these small bundles ended below. Ray Society, 1849, p. 69.

Duchartre ("Éléments de Botanique," p. 179) says: "Il se réduit à l'état de filament délie à son extremité inferieure."

‡Blending is mentioned by Lestiboudois (V. Literature at end), by Unger, and by Von Mohl. Ray Society, 1849, p. 8.

direction of the apex of the phylophore. When in the process of development, a bundle has a frond or spadix formed in connection with it, it is clear that the base of this frond, being left behind by the growth of stem and bundle, must at some time become a scar upon the side of the stem, and as the developing point of the bundle is always near the apex, the bundle will be formed more or less in a line connecting the scar or point of branching and the apex of the phylophore which is in the axis of the stem. But although the bundle is formed in this line, it does not follow that on the growth of the trunk it will be found in a straight line from the scar to the apex. In reality we find the lower extremity of the division as nearly as may be parallel to, and very near the side of the stem. This will be better understood from figs. V, VI and VII.

Let C be the apex of the phylophore at which a bundle branches. In the process of growth of the phylophore, the point C will be left behind at D, and the growing division of the bundle, pointing always toward the centre, will be developed in the direction DC or JI, practically very nearly parallel with the side CHD. Now when the apex is far beyond the original point of branching of this bundle, say at A, while the original point of C is at B, this part of the bundle that was formed first after the branching took place, will still have its original relation to the side of the stem, that is, it will be about parallel to it. When the point C is left at E, the direction will be still further changed, and will be IK, farther from the periphery, and when IK is left far behind it will be in a position like MN in figure V. Then again when the point C is left at B (Fig. V) we shall have the part IL forming, and thus will the growth of the bundle in length gradually approach it to the axis of the stem. Upon its arrival at a sufficiently advanced stage of development to take its place again, and again have a frond developed in connection with it, it will have crossed in its course all the bundles that have branched since it branched at C originally. I would suggest that this development of the fibro-vascular bundles, always in the direction of the apex, is due to the light. This apex, at its central point, is very pulpy and translucent, while its sides are enveloped by the young and growing fronds, which render the parts surrounding the centre more or less opaque.

The outward curve of these bundles is a simple matter. It marks the line traversed by the base of the frond from the time it originated at the apex of the phylophore until it reached its place on the side of the trunk. In figure VIII, let C be the centre of the growing part at which the frond and bundle connect. Now when the apex has grown to C′, the point C will have been left behind at A upon the side of the growing cone, and when the apex is at C′′′′, the point which was originally at C will have taken its place at E upon the side of the stem. In this outward curve, the longitudinal growth of the bundle is shown. In figure IX if C be the former position of the apex at which a frond was developed, and which takes its place later upon the surface of the stem at D, it might be inferred that CF were the vertical distance grown by this section of the stem from

the time the frond originated at C until it reached D. But such is not the case, for some allowance must be made for the increase of altitude caused by the side CG becoming parallel with the lower part of the stem. Taking GC as a radius and describing CI, the distance IE must be deducted as this difference in altitude of the point C when it reaches I, and the length grown by the whole section is FL or DI. It is true that when C reaches D, CF will be the difference in altitude made by C, but this is not all due to the growth in the length of the fibro-vascular bundles. In actual hemisections of palm stems it is noticeable that the curve CD is not an even one, but has a shorter radius near the point D. This is due to the fact that during the younger stages growth was principally in length, while as the part approached maturity, the lengthening was less marked, and the lateral growth predominated. This growing in size after prolongation has ceased is a characteristic of the fibro-vascular bundles in the palms. In the phylophore, the lengthening of the bundles is still possible to a limited extent, but it will be shown later that the growth in size continues even below the phylophore. It will also be seen later that this increase in the size of the bundles, and consequently in that of the whole stem after longitudinal growth has ceased, causes the fronds to droop more.

It has already been observed that the fronds are developed in connection with the *central* bundles in the phylophore. In regard to the origin of the bundles it is sufficient at present to say that they originate at the apex of the phylophore, and are developed in it, with it, and as a part of it. Von Mohl and Mirbel maintain that these bundles grow up into the phylophore; Gaudichaud that they grow downwards from it—from the frond bases; Von Martius that they grow both up and down, while I maintain that they are perfected in all directions at the same time, though the lateral growth continues to a certain extent after the longitudinal growth has ceased, and that they can no more be said to grow upwards or downwards than can it be said of the bones of the body that they grow outwards into the limbs. It is true that the general lengthening of the bundles takes place at the superior end, but there is a growth beside this. At the first appearance of the fronds at the apex of the phylophore the fibro-vascular bundles are already connected with them, and just as intimately as they are in the perfectly developed frond. The internodes at this point are very short, but the bundles are the same in number, and have exactly the same connections, directions, and relations to each other that they have in later life. But in the perfected frond we find them larger, longer and harder, and in the perfect stem the internodes are longer, the stem and bundles larger, while the whole plant has grown both longitudinally and laterally. In view of this general growth, the relations of the parts remaining the same, it is clear that growth does take place in all directions. In figure IX, p. 471, the upward and downward growth of a bundle is represented approximately by the line CD. This line cannot be upward growth alone, for the point D was once at C,

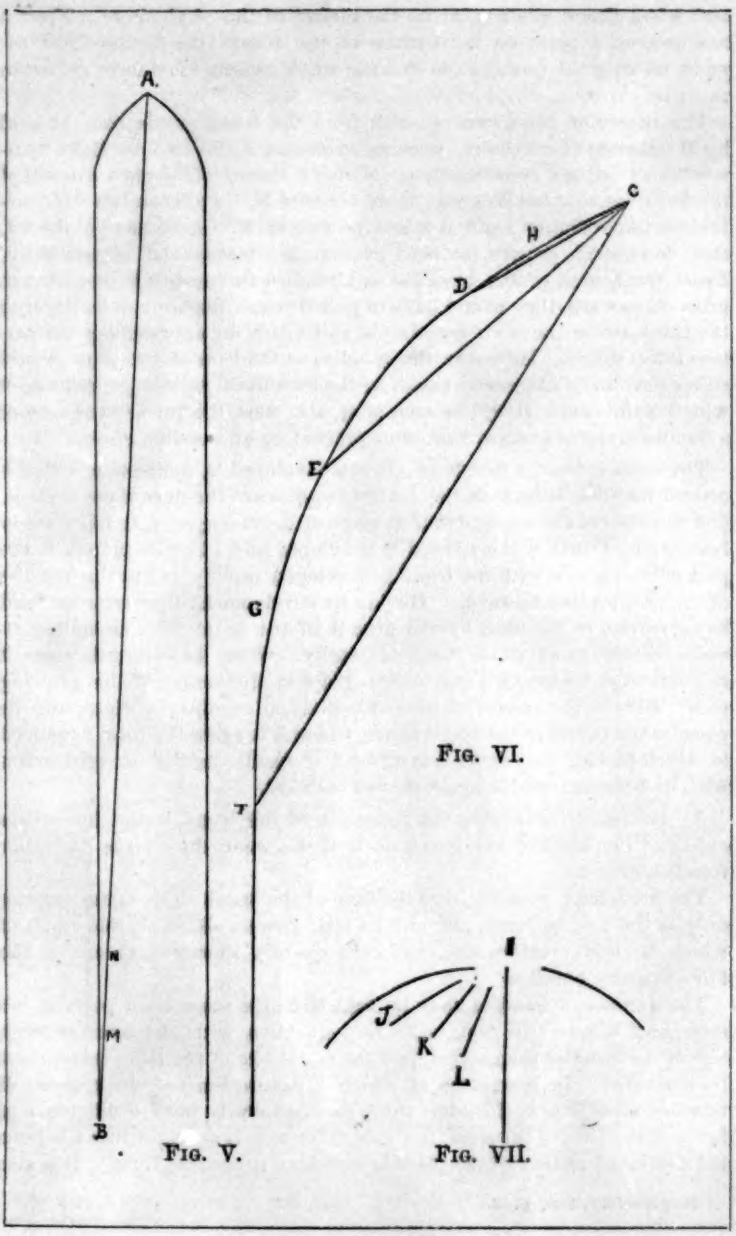


Fig. V.

Fig. VI.

Fig. VII.

and when there, was a point on the surface of the phylophore. Now it has become a point on the surface of the trunk, the distance CD beyond its original position. so that the whole bundle must have grown in this part.

The theory of downward growth from the frond to the base, as held by M. Charles Gaudichaud, appears to me, as it did to Von Mohl,* unworthy of serious consideration. Mirbel's theory of upward growth of the fibro-vascular bundles was denounced by M. Gaudichaud as a physiological impossibility; and it might be said of M. Gaudichaud's theory, that downward growth, as held by him, is a mechanical impossibility. From the course of the bundles, as already explained, it is seen that to grow downward, they would have to pass through the bony outer layer of the trunk twice: once on entering it, and again on approaching the surface lower down. Moreover the bundles at the base of the trunk would either have to be extremely small, or the base itself very large, neither of which is the case. It will be seen later, also, that the lower extremity of a bundle division hardens first, thus precluding all possible growth.

The reason that the fronds are always developed in connection with the central bundles, is because the central bundles are the ones there present, and the ones in the most advanced stage of development. It has already been noticed that when a frond is developed and a bundle branches, the part in connection with the frond is developed rapidly and at the expense of the part leading upwards. Having its development thus retarded, and being carried to one side by the growth of the trunk, this ascending division is attenuated at its lower extremity. Other bundles gain upon it in point of development, and take its place at the centre of the growing part. But in the course of time this division regains its vigor, and its place at the centre of the phylophore, where it is again the most advanced in development, and again has a frond or spadix formed in connection with its branches, and is again curved outward.

At the time of branching the formation of the frond is the immediate object of the bundle, but provision is at the same time made for other fronds higher up.

The branching goes on from the base of the trunk to its apex, varying only as the tree becomes old, and its vital powers diminish, the result of which is shorter internodes, and consequently shorter divisions of the fibro-vascular bundles.

The number of bundles may be said to be the same in all parts of the stem, and it is to this fact, taken in connection with the average even size of the bundles themselves, that the equal size of the palm trunk must be attributed. In specimens of which I have estimated the number of bundles at different altitudes, there has generally been a difference in favor of the base of the stem, but this difference is so slight that I believe the decreased vitality of the plant is sufficient to account for it. It is also

* Ray Society, 1849, p. 52.

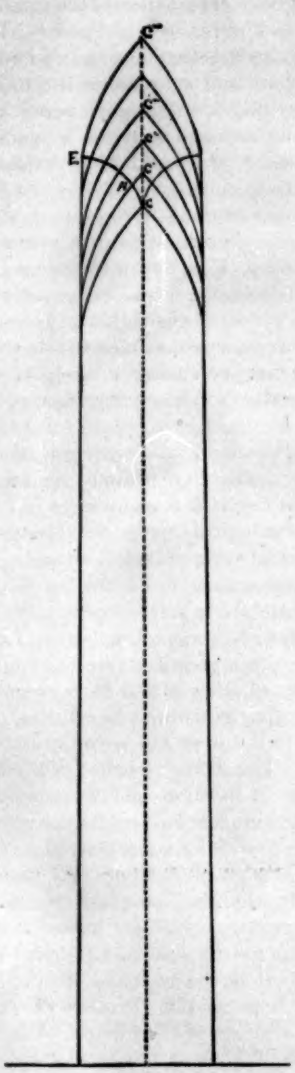


Fig. VIII.

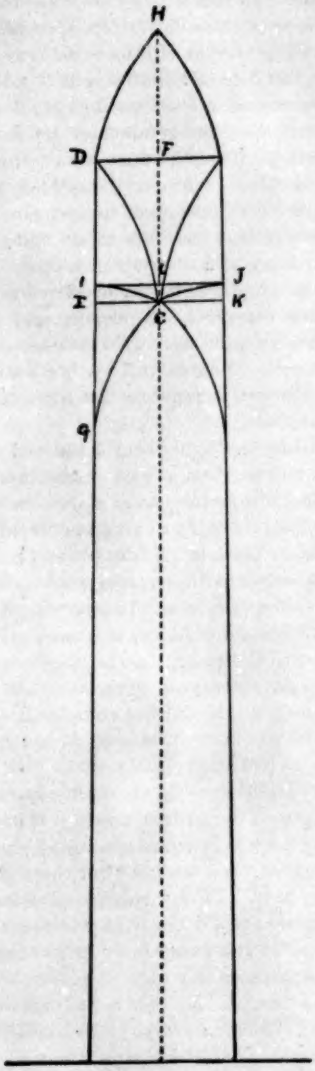


Fig. IX.

possible that the same number of bundles was present in the upper sections as in the lower ones, but that being smaller, they escaped my attention. In this connection I will refer to Mirbel's explanation of the spindle-shape of the stems of *Iriartea ventricosa* and *Acrocomia lasiopatha*. Referring to Von Mohl's theory, as originally stated, that all bundles ended in the base, M. Mirbel said:* "Il est un fait dont sans doute M. Mohl a connaisance, c'est qu'il existe des Palmiers pourvus d'un stipe mince à la base, mince au sommet et notablement renflée dans sa partie moyenne. Ce stipe resemble donc a une enorme fuseau * * * * * Je demande a M. Mohl comment il explique cette anomalie en restant fidèle a son hypothèse. Pour moi, rien de plus simple depuis que j'ai reconnu dans le Dattier que les filets naissent de bas en haut, de tout le pourtour interne du stipe, et à toutes les hauteurs. A la naissance de l'arbre fusiforme, la végétation est faible, les filets sont peu nombreux, et par consequent la stipe est grêle. A mesure que l'arbre s'éleve, la végétation devient de plus en plus active, le nombre des filets augmente sensiblement, le stipe grossit. Mais quand l'arbre a atteint une certaine épaissure la végétation s'affaiblit, le nombre des filets diminue, le stipe va s'amincissant jusqu'au sommet."

Had M. Mirbel ever examined the trunk of one of these fusiform palms, or had he even read a description of their method of growth, he never would have tried to explain this increase in size in this manner.

I am not able to give at present the physiological reason for this peculiar growth, but I am able to give some explanation of how it occurs. In transections these palm stems show the same number of bundles in the swollen part as in the more slender parts both above and below it. When there is a difference, it is such as may be found in any palm having a cylindrical trunk. In the swollen part there is a great increase of cellular tissue, and a very slight increase in the size of a few of the fibro-vascular bundles. M. Mirbel represents this enlarging as taking place during the growth of the tree, and at the top, whereas it does not occur until the palm has attained almost its full growth. The *young Iriartea ventricosa* never shows this enlargement in any part of its stem, and when it does occur in the grown plant, it is at a considerable distance below the growing part.† In some species of *Acrocomia* the swelling takes place near the summit, but always after the crown of leaves or phylophore has passed the part. In one species examined at Asuncion, in Paraguay, the trunk has no certain point at which it swells, but may swell out either at the base or the summit, or anywhere between the two parts, and there are many cases in which there are swellings both at the base and just below the fronds. Neither is the tapering of a few palms like *Oreodoxa oleracea* and *Euterpe oleracea* to be explained by a decrease of the number of fibro-vascular bundles toward the top. In examining many trunks of *Euterpe*, I found the number of bundles near the base and near the top about the

* Comptes Rendus de l'Acad, 1843, II, p. 1123.
† Wallace's "Palms of the Amazon," p. 37.

same, but I always found, where there was a decided tapering of the trunk from base to summit, that there was a difference in the size of the bundles, slight to be sure, but quite as marked as the difference in size of the two parts of the trunk. This difference in the size both of the trunk and of the bundles is more noticeable in *Oreodoxa oleracea*, or the royal palm, than in any other palm which came under my observation.

I have spoken of the branching of the fibro-vascular bundles and their return always to a frond base, as if their course was on the same side of the trunk and in a vertical line. Neither is the case. It often happens that instead of returning to a frond base upon its own side, the bundle crosses through the whole stem and connects with one on the side opposite.* Mirbel claimed that in the date palm, the bundles all crossed from one side to the other. I shall not say this is not true of the date palm, for I am well aware that there is a great variation of structure among palms, but I have never found this crossing from side to side to be the rule, although it often occurs, and is more marked in some palms than in others.

In addition to this occasional crossing the stem, the bundles have a winding direction, so that their course is not directly vertical, but spiral, both right and left, about the stem, part of them going to one side and part to the other. From base to summit then, a bundle may be said to have a spiral plane within which it grows, and whether it returns to the surface upon the side on which it originated or upon the opposite side, it is always in this spiral plane. Meneghini tried to explain this spiral direction of the bundles as a mechanical result of the growth of the tree whereby the relative sizes of the trunk and frond bases became changed. He supposed the fronds upon the apex to be arranged in a helix, and that as the tree grew this helix developed into a spiral line upon the stem. He believed the leaf bases to be always of the same size, both upon the growing cone and upon the stem. The growth of the trunk then, and the unchanged size of the bases of the fronds necessitated a drawing of the bundles toward these bases, which resulted in the spiral direction.

But I have observed that the relative position of the fronds is always the same, a matter which Von Mohl was in doubt about. The spiral direction of the bundles is in no way a mechanical one, but exists alike in stem and phylophore as I have often observed, and until some better reason can be assigned for it, must be considered as organic.

The existence of a palm having its fronds arranged in one plane† would of itself be sufficient to upset Meneghini's theory of the helix and spiral. This spiral direction of the fibro-vascular bundles is an important one,

* Dr. Von Martius believed this to be the case, as will be seen in the Comptes Rendus de l'Acad., 1845, Vol. I, p. 1038.

† About Pará and the mouth of the Amazon a distichous palm is very common. It is popularly known as the *baccába*, and is the *Œnocarpus baccaba* of Martius. *Urania speciosa* and *U. amazonica* are other distichous monocotyledons.

both in connection with the structure of the plant, and in its influence upon the plant's general appearance.* It varies greatly in different species, and may be almost wanting. In trying to split palm stems, those in which the spiral direction is less marked, split more readily than those in which it is more decided. It is not very marked in *Mauritia caraná*, *Euterpe*, and *Iriartea*, while in *Maximiliana* and *Manicaria* it is a very prominent feature.

It is not in the trunk alone that spiral direction is to be seen, but it is more or less observable in the fronds and spathes. The trunk may have a very decided spiral direction in its fibro-vascular bundles, which may be wanting in the fronds, and *vice versâ*. *Raphia tædigera* (vulg. *Jupatý*), for example, has a marked spiral direction of its bundles in the trunk, while the petioles of the fronds split with almost perfect evenness. Spiral direction in spathes is well shown in the spathe of *Manicaria saccifera* (vulg. *Ubussú*), which resembles coarse cloth somewhat.

In the petioles and midribs of some palms, modifications of spiral direction give rise to peculiar and characteristic forms of midribs, resulting in changes of the leaf planes from a horizontal to a vertical position, which are characteristic of the species in which they occur.

It has been noticed by those who have studied and observed palms in their native forests, that, after a certain amount of experience in familiarizing one's self with the general appearace of them, the common palms can be distinguished at almost any distance at which they are visible, if only the fronds can be seen. In those having pinnate fronds this is very largely due to the effects produced by changes in the leaf planes, which are the result of changes in the shapes of the midribs, which, in their turn are the result of the direction of the fibro-vascular bundles. In the *Maximiliana regia* Mart. (vulg. *Inajá*) and *Attalea excelsa* (vulg. *Urucurý*) of the Amazon region, and in *Acurý*,† of the upper Paraguay, the bundles in the midrib are turned to one side as shown in figure X, page 477.

In No. 1 is shown a section across a midrib not far from the trunk, where it has the usual shape of a midrib. In No. 2, a section further outward, the bundles of the side CB (1) have moved up and gone to form an extension of AB, while a corresponding number from the side AC have taken their places on CB. The result is a figure like No. 2. No. 3 represents a section still further out, and No. 4 is one near the tip, this direction to one side being more marked the nearer we approach the end of the frond. The midrib assuming these forms, it is impossible for the frond to maintain its horizontal position, whereupon it changes its leaf plane from a horizontal to a vertical position, and droops over on its edge. It might be supposed that this twisting of the frond is due to some arrangement of the leaflets with reference to the light, but in the *Maximiliana regia* (*Inajá*) the tips of the fronds are completely inverted in a great many

*I have not studied the relation of the spiral direction of these bundles to the phylotaxis, but I suggest that the two are related.

†Botanical name not known.

cases, if not always, so that what was originally the lower side of the frond is turned upwards.

In a number of transections of a large, living and nearly grown palm stem, in those made near the base, it is found that the fibro-vascular bundles are all black, if black be the characteristic color of the mature bundles,* except a few in the centre. A section made anywhere below a certain distance from the fronds would show the same general character as regards hardness and color. But on coming near the growing part the sections appear less and less colored, and above the fully-matured fronds they are all found to be colorless. Dissecting out these bundles in the phylophore we find that those already colored, or nearly so, connect with the lower or more mature fronds, while those connecting with the younger fronds are, for the most part, colorless; and, when showing any color at all, it is only at the lower extremity of the division. We find, then, that there are uncolored bundles near the base of the trunk at the centre, and also all through the section near the top. I therefore place these facts against the theory of Mirbel, that the color of the bundles is due to age alone,† and also against that of Von Mohl, which is that color is due to position alone. In regard to this coloring, the element of age is a necessary one when the division is considered longitudinally, for in this case the bundle is colored for a short distance at the upper end where it passes in to the centre, then follows a part in which it is comparatively uncolored, while the remainder, and larger part, is colored. But in considering a transection of a trunk with reference to the coloring of the bundles, position is the necessary element. This is because the lower extremities of the divisions begin to color and harden before any other parts, and, as has already been explained, these lower extremities lie next the surface of the stem.‡

Thec omplete hardening and coloring of the fibro-vascular bundle divisions does not take place until the frond or spadix, with which they are connected at their upper extremities, have fallen or died. As has already been mentioned, the bundle divisions begin to harden and color at their lower extremities before the frond or spadix dies, but not before it is unfolded and active. At the fall or death§ of the frond the hardening and coloring are complete, and this marks the limit of growth of the division bundles originally connected with it. As far as these hard, colored bundles

* Some palms have the mature fibro-vascular bundles of a waxy color, such as *Oreodoxa*, *Euterpe* and *Geonoma*; others have them of a deep, reddish-black, like *Mauritia*; while the majority of them are black. Examples: *Acrocomia*, *Guilielma*, *Astrocaryum*, *Bactris*, etc., etc.

† Ray Society, 1849, p. 82.

‡ The edible part of the "palmito" of Brazil and of the "cabbage palm" of the West Indies, is the long phylophore in which all the fibro-vascular bundles are soft and colorless.

§ I mention the falling *or* death of the frond because in some palms the fronds fall as soon as they die, while in others they cling to the trunk for a long time after death. Ex.: *Acrocomia lasiospatha*.

are concerned, the growth of the whole stem is at an end. In fact, however, the stem does continue to grow to a certain distance below the phylophore, but this growth is lateral and not longitudinal. A palm trunk may grow laterally as long as the fibro-vascular bundle divisions of the given part are in connection with active fronds.* It is plain, then, that there can be no longitudinal growth below the lowest active fronds. But in regard to lateral growth, there is no practical line of demarkation between the full-grown and growing parts of a trunk, because full-grown and growing parts overlap each other. Theoretically the growth has ceased below the lower extremity of the bundle divisions connected with the lowest active fronds. Practically it varies much with the species, age, vitality and circumstances of the individual.

Being impossible below the fronds, longitudinal growth is necessarily confined to the phylophore or part above the lowest active frond. We may therefore naturally expect to find palms that have long phylophores attaining considerable heights, and having the internodes long. In almost all young palms, whatever the species, we find the phylophore very much longer than in full grown ones of the same kind, and the internodes longer in the same proportion. The young *Mauritia flexuosa* has its active fronds covering it down the trunk four or five times as far as an old individual of the same species, and the same is true of all the palms I can now call to mind. But this long phylophore gradually shortens with age, while the internodes shorten in the same proportion, and the fronds have a more decided drooping. In genus *Desmoncus* the trunk is covered with active fronds for a large part of its whole length, or, in other words, it is nearly all phylophore, and, as might be expected, we find it attaining enormous lengths,† with a very slender stem and long internodes, in comparison to its size. The length of the phylophore in this genus, as compared to its size, has caused it to assume the habit of a clambering or climbing palm. It reaches so great a length before any of its fronds cease to be active, that is, before any of its fibro-vascular bundles harden, that it is incapable of sustaining its own weight. If an *Assaí* (*Euterpe oleracea*) palm retained its fronds active to the same length proportionally that *Desmoncus* does, it would grow to be about a hundred feet long before its fibro-vascular bundles hardened near the base, and the result would be that it would fall over and become a clambering palm. The slender trunk alone of *Desmoncus* is not sufficient to account for its habit, for it falls over while it is still a mere shoot, not more than three or four feet in length. Then too there are many palms even more slender than *Desmoncus*, palms

* Sachs (Text-Book, p. 552), says that "each portion of the stem, when once formed, maintains the thickness which it had already attained within the bud near the apex of the stem." There may be some palms of which this is nearly true, but it is far from being true in all cases, while it leaves the swelling of spindle-shaped trunks as badly accounted for as do the explanations of M. Mirbel.

† I have seen this palm over thirty metres long with a stem but little more than one centimetre in diameter.

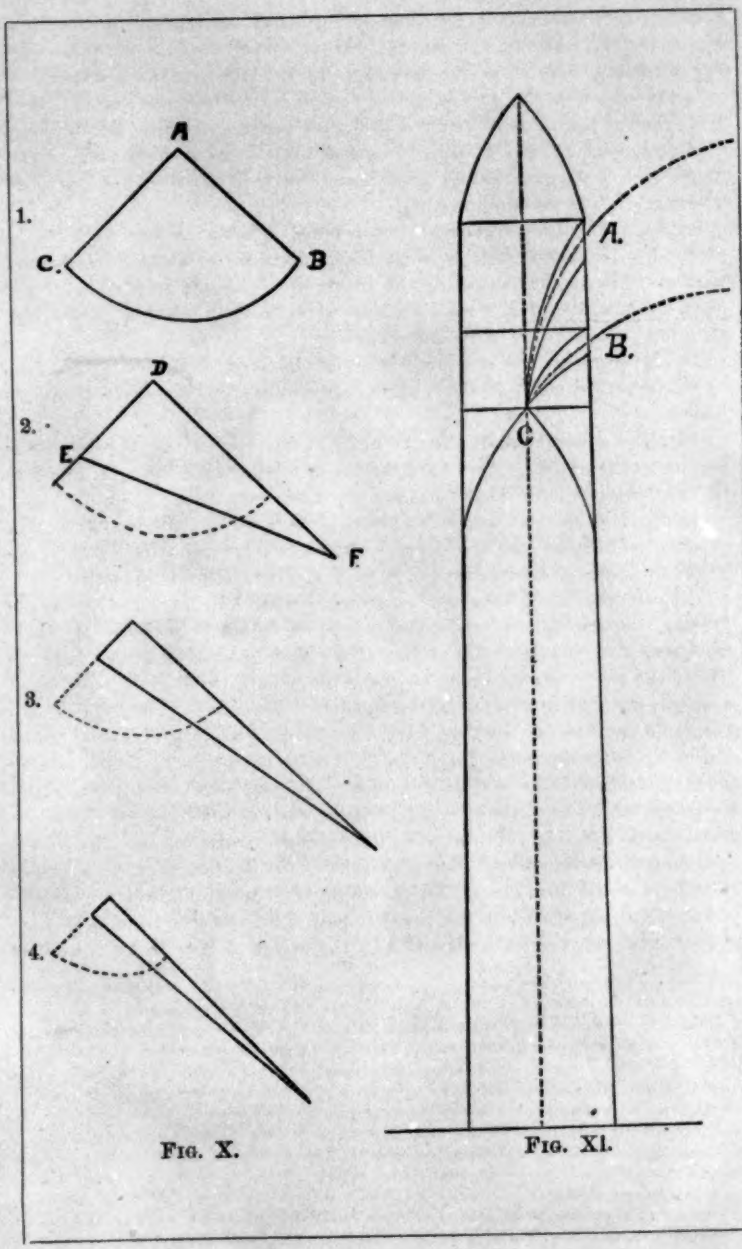


FIG. X. FIG. XI.

whose trunks are not larger than an ordinary lead pencil, but which, having the phylophore comparatively short, have the fibro-vascular bundles hardened early, and are consequently perfectly upright in habit.

I have not seen the Asiatic genus *Calimus* growing, nor have I been able to see any careful description of it, but judging from its slender stem and long internodes, I venture to guess that it has a very long phylophore, and to suggest that its great length and clambering habit is to be explained in this same manner.

Speaking of palms in general, in the same individual, the length of the internodes has much to do with giving it character as seen in its general appearance. As the length of the internodes, the age and vigor of the plant, and the drooping of the fronds are all intimately related, I will speak of these subjects in the same connection.

The drooping of fronds which is so much more marked in old palms than in young ones, in feeble than in vigorous ones of the same species, is caused :

First. By a decrease of the strength and vigor of the fibro-vascular bundles of the midrib. This variation in the strength of the midrib effects the drooping of the frond throughout its whole length.

Second. By the decrease of the vital powers of the whole plant, from which it results that the angle made by the outcurving bundles with the axis of the stem is larger than in the case of more vigorous growth.*

This effect can be seen by diagram, figure XI, in which C is the point of the phylophore where a frond is originated. In a case of feeble growth, the frond would stand out at B, making a large angle with the axis of the stem, while in case of vigorous growth, it would stand out at A, making a comparatively small angle with the axis. The result of difference in growth is very distinctly seen by comparing the young plants with old ones of the same species grown on the same soil. In the young ones the internodes are invariably† longer, and just as invariably the fronds are more erect. The fronds being continuations of the bundles, the angle made by the bundles with the side of the stem is continued into the fronds under slight modifications. The effect of this angle upon the fronds is also noticeable in the phylophore, for the angle at which the bundles cross the periphery being smaller in the cone-shaped apex, the fronds have a more nearly erect position. In figure XII, the upper fronds make a smaller

* Hence the angle of drooping in fronds, taken alone, is not always a specific characteristic, as stated by Wallace in his "Palms of the Amazon," p. 5.

† Peculiar circumstances may change this, as I once saw well illustrated in the case of a *Mauritia flexuosa* near Pará. The whole trunk was about thirty metres high, and about six metres below the fronds, the old scars were very close together, and the trunk had every appearance of having completed its growth at that point. Above this, however, the trunk appeared to have renewed its youth, and the internodes were long and smooth like those of a vigorous palm. In seeking the possible explanation of this new growth, I found that the place where the palm stood had, a great many years before, been a forest, and that it had originally stood in the edge of a stagnant pool which had been drained. Whether these were the causes of the renewed vitality there were no means of ascertaining, but the evidence of that vitality was unquestionable.

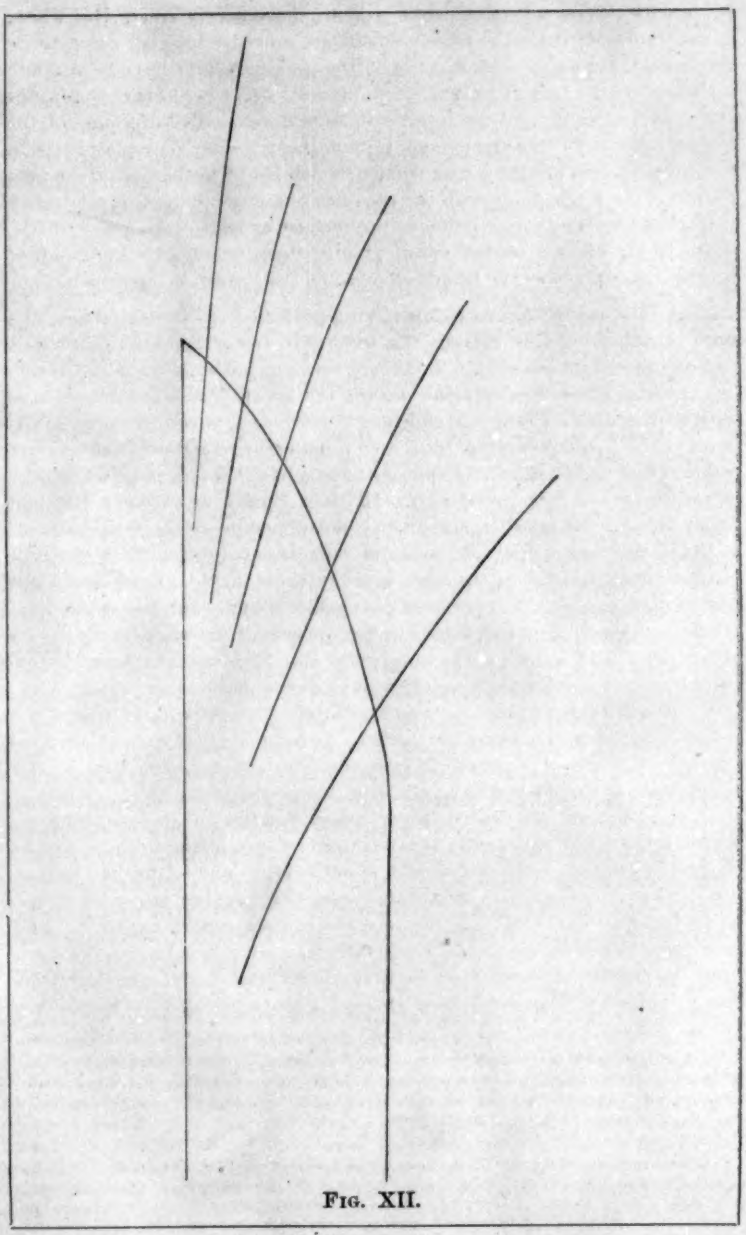


FIG. XII.

angle with the surface of the apex, and are more nearly erect. But when, in the course of time, the fronds which are now the highest, come to be the lowest, the angle they make with the periphery will have been much increased by the lateral growth of the trunk, which will bring the fronds out at shorter radii, and the result will be a more decided drooping of the lower fronds. In this arrangement upon the growing part is a provision for the weakness of the young fronds, which could not sustain their own weight if the angle made with the trunk were a larger one. I have already explained that the shorter radius at the surface, as seen in the lower fronds, is due to the lateral growth being greater than the longitudinal, and, of course, takes place as the fronds come to be the lowest in the crown.

I have also stated that in palms having perfectly cylindrical stems, the fibro-vascular bundles *average* the same size from the base to the upper end of the full grown part. They vary however in each division, reaching their greatest development within the trunk just where they curve outwards to connect with the external growth, and beyond this to a distance in the petiole varying with the length and weight of the normal frond. The variation in size appears to be due to the purpose which the bundle serves at the given part. In those palms which have long and heavy fronds, the bundles are greatly developed near the base, and in addition, they assume structural forms capable of adding to their strength in the manner needed by the tree, while in those having short and light fronds there is comparatively little development of the bundles at the bases of the petioles.* The frond of *Raphia tædigera* (*Jupatý*) is noted for its great length and weight.† In this palm the fibro-vascular bundles are cylindrical, or reach their greatest lateral development just at the juncture of the frond with the stem, and are flattened laterally in the base of the petiole, the upper edge being the thicker. This shape gives them about three times the strength they would have in the ordinary cylindrical shape, for supporting a weight applied as it is in this part of the petiole. There is another structural peculiarity about these bundles in *Raphia tædigera*, which I have not sufficiently investigated. When a frond dies, it breaks off just beyond the enlarged part of these bundles, and in time the broken petiole that remains fast to the trunk decays, leaving the larger fibro-vascular bundles exposed. In this condition, one might expect to find them bent downwards by the strain of great weight sustained by them from the beginning until they became rigid. But so far are they from being warped downwards, they ar not even straight, but bend back

* *Jupatý*, *pataúá*, *murumurú*, *urucurý* and *uaúassú* all have large fronds, and proportionately large fibro-vascular bundles in the bases of the petioles. *Assaí*, the *marajás*, the *paxiúbas* and *mucajás* have small fronds, and small bundles in the bases of their petioles.

† I have measured fronds of this palm that were fifteen metres long. Wallace says he has seen them fifty feet long. V. Wallace's "Palms of the Amazon," p. 43.

in exactly the opposite direction to that given them by the drooping of the frond.*

Gaudichaud maintained that the fibro-vescular bundles of the palm-trunk ran down into the roots. My own observations agree with those of Von Mohl, that there is no such direct connection between the bundles of the stem and those of the roots. Anyone acquainted with the habits of such a palm as *Iriartea exorrhiza* could never have conceived a theory so out of keeping with the facts of the case. This palm puts out new roots continually, as do almost all palms, and always above the older ones. If the bundles of the trunk ran directly into the roots, the same roots would have to serve the tree through its whole lifetime, for the number of bundles in the trunk does not increase. To be sure, Gaudichaud maintained that the bundles descended from the fronds to the roots, and granting his premises there might have appeared to be some reason in this conclusion. But the supposition that the bundles ran downwards necessitates, as a consequence, a base much larger than the upper part of the trunk, as well as a continually increasing one, or else very small bundles at the base. None of these things are found to be so, but it is found that the bundles of the trunk do not run into the roots.

Von Mohl considers the spines on the aërial roots of *Iriartea exorrhiza* to be aborted rootlets, and directly connected with the fibro-vascular bundles of the roots. I also found them to be aborted rootlets, but they are as independent of direct connection with the bundles of the roots proper, as are the roots themselves of the bundles of the trunk.

In conclusion I find : (1) that all fronds and spadices originate at the centre of the phylophore ; (2) that the fibro-vascular bundle division continues to grow until its frond reaches maturity ; (3) that the growth of a palm trunk continues as long as the bundle divisions of the part are in active connection with living fronds, and no longer ; and (4) that the growth of palms is therefore an internal growth, and the term endogen is not a misnomer as far as palms are concerned.

From another point of view I find, that the outward appearance of a palm, the form of its trunk, the plume-like drooping of its fronds, the motion given them by the wind, the breaking and twirling of its leaflets, and its general picturesque beauty are only the outward manifestations of the laws of its internal growth and structure.

* Another interesting point in regard to the bundles in the fronds is the direction in which they face. (For want of a better definition I have spoken of the side of the bundle connecting with the parenchymous system as the face.) I have not made a sufficient number of observations to enable me to speak authoritatively upon the subject, but in the few instances in which I observed this facing of the bundles, they tended to face the centre in the petiole and midrib just as they did in the trunk. In order to assume this position the bundles in the lower side of a frond retain the position they have on leaving the trunk, while the upper ones twist one way or another in what seems an endeavor to turn over and face the centre of the new stem—that is, of the petiole.

PROC. AMER. PHILOS. SOC. XXI. 115. 3I. PRINTED MAY 29, 1884.

NOTE:—The preceding discussion is based upon direct personal observation and study of a large number of specimens of the following genera, together with others, the botanical names of which I do not at present know:

Acrocomia,	Desmoncus,	Mauritia,
Attalea,	Euterpe,	Maximiliana,
Astrocaryum,	Geonoma,	Œnocarpus,
Bactris,	Guilielma,	Oreodoxa,
Copernicia,	Hyospathe,	Raphia.
Cocos,	Iriartea,	

THE LITERATURE OF THE SUBJECT.

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SCHLEIDEN:

Grundzüge, II., 189.

Stated Meeting, May 2, 1884.

Present, 9 members.

President, Mr. FRALEY, in the Chair.

New members, Mr. Baker, Dr. Garrison, and Prof. James, were presented to the presiding officer, and took their seats.

Acceptances of membership were read from

Prof. E. J. James, dated Philadelphia, April 22.
Mr. Wharton Barker, Wynoote, Jenkintown P.O., Apr. 23.
Dr. Joseph F. Garrison, Camden, N. J., April 25.
Mr. Francis Jordan, Jr., Philadelphia, April 25.
Mr. Jno. R. Baker, Philadelphia, April 25.
Mr. Rich. L. Ashhurst, Philadelphia, April 25.
Prof. Henry S. Frieze, Ann Arbor, Mich., April 28.

Mr. Francis Wharton declined membership by letter dated Philadelphia, April 29, assigning as a reason his inability to attend the meetings.

Change of address, Geo. L. Vose, Prof. of Civ. Eng., in the Mass. Inst. of Technology, Boston.

A circular letter to attend its 25th anniversary on the 11th of May, was received from the Offenbacher Verein.

Acknowledgments were received from the Royal Bavarian Academy of Science (two copies of XVI, i; and of 110–113); Holland Society of Science (XVI, i; 112, 113); E. H. R. Peters (114); and the Smithsonian Institution (114).

Envoy letters were receivrd from the Belgian Ministry ot the Interior and the Musée Guimet.

A letter was received from Brentano Bros., booksellers, New York city, appointed agent for the Bib. Nat. de Paris, desiring the Society's publications and bill for the same.

A letter of advisement was received from the Royal Institute of Higher Studies at Florence.

Donations for the Library were reported from the Department of Mines, at Melbourne; Royal Society, New South

Wales; Central Bureau of Statistics, and Bibliothèque Royale, at Stockholm; Accademia dei Lincei; Société de Geographie, Revue Politique, and M. Paul Chevallier, at Paris; Victoria Institute, Royal Astronomical Society, Royal Meteorological Society, Mr. William Marriott, and Nature, London; Royal Society of Edinburgh; Boston Society of Natural History; Massachusetts Historical Society; S. E. Cassino & Co.; Library of Harvard University; American Journal of Science; Meteorological Observatory, at New York; New Jersey Historical Society; Franklin Institute, Hibernian Society, Commissioners for the erection of the Public Buildings, Charles A. Ashburner, and Henry Phillips, Jr., of Philadelphia; M. H. Boyé, of Lehigh county, Pa.; the Second Geological Survey of Pennsylvania; Johns Hopkins University, and United States National Museum.

Mr. Phillips made a communication "On a supposed Runic inscription near Yarmouth, N. S.," and exhibited a photograph of a squeeze from it.

Mr. Ashburner exhibited recently printed sheets of Cross-sections, made by the Geological Survey, in Schuylkill and Luzerne counties, and explained some of their curious exhibitions of structure.

Mr. Fraley reported that he had received the Michaux rentes last due (April 1), amounting to $133.39, and had paid them over to the Treasurer.

The pending resolution on change of Order of Business was postponed for consideration at another meeting.

And the meeting was adjourned.

Stated Meeting, May 16, 1884.

Present, 10 members.

President, Mr. FRALEY, in the Chair.

A photograph of Prof. H. S. Frieze, of Ann Arbor, Michigan, was received for the album.

An acceptance of membership was received from Mr. Samuel Dickson, dated 901 Clinton street, Philadelphia, April 20.

Letters of envoy were received from the Batavian Society of Sciences, through the Minister of the Netherlands and the United States Department of State; Fondation Tyler; Central Observatory of St. Petersburg; Musée Guimet, and the United States Census Bureau.

Donations to the Library were received from the Batavian Society of Arts and Sciences; the Royal Academy of Belgium; the Accademia dei Lincei; the Royal Academy of Arts and Sciences in Modena; the Geographical Society at Paris; the Geographical Society at Bordeaux; the Meteorological Council of the Royal Society; Dr. Benjamin Ward Richardson, and London Nature; the Toronto Observatory; the newly organized Bostonian Society in the old State House; the Museum of Comparative Zoölogy; Dr. Samuel Abbott Green; the American Chemical Society; the Meteorological Observatory in New York; the American Journal of Pharmacy; the Pennsylvania Magazine of History and Biography; Mr. Richard Vaux, Mr. Henry Phillips, Jr., Dr. Persifor Frazer; the American Chemical Journal; the American Journal of Mathematics; the United States Naval Institute; the United States Fish Commission; and the American Meteorological Journal.

The death of Dr. Samuel D. Gross, at Philadelphia, May 6,

aged 78 (born July 8, 1805), was announced; and Dr. DaCosta was appointed to prepare an obituary notice of the deceased.

Prof. Cope described the rich collections of vertebrate fossil remains in the Muséo Nacional under the care of Dr. Barcena, and in the Museum of the School of Mines in the care of Prof. Ant. Costino, which he had examined during a recent visit to Mexico—Glyptodon, Mastodon, Elephas, Equus, Llama, Bear, Dog and Deer, and the several genera and species into which they seemed divisible, some of them being undescribed. Important geological points he reserved for another communication.

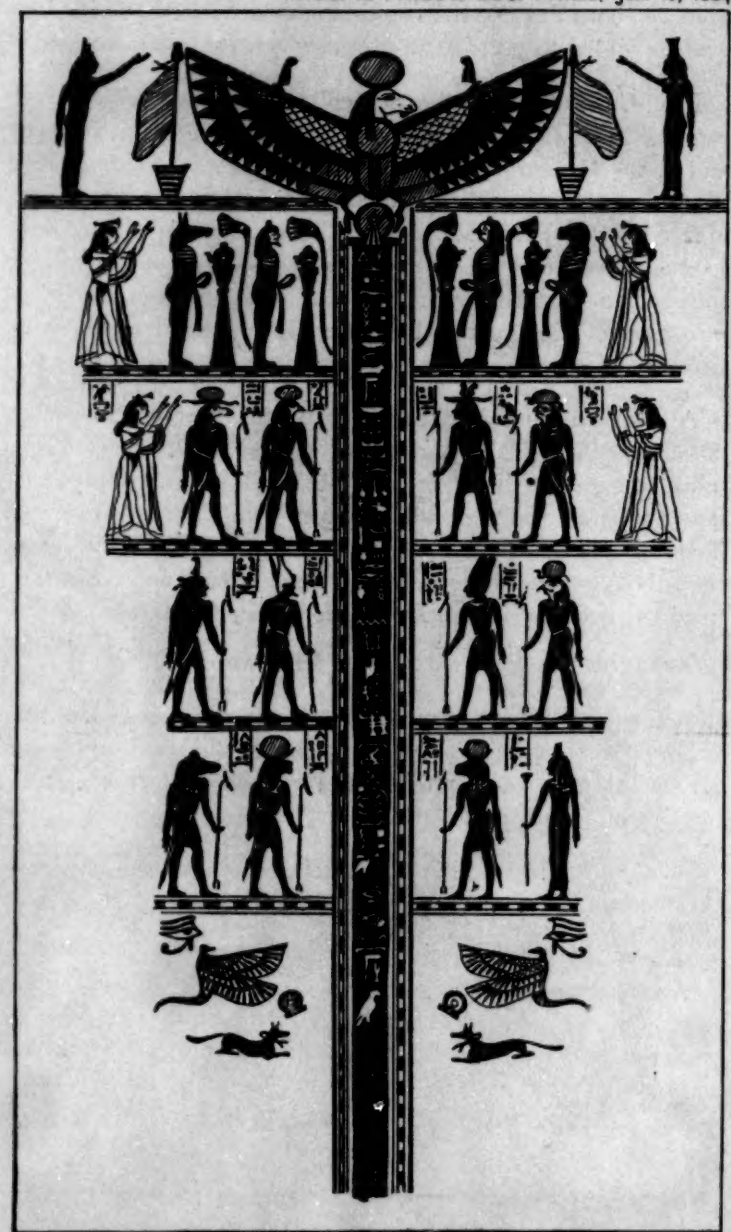
A question from Mr. Hale elicited the opinion, that while no certain proof that man was coëval with either mammoth or elephant had yet been obtained, yet that facts calculated to give the supposition much probability multiplied. The discovery of human facial bones in an uplifted silico-calcareous bed, on the shore of Lake Tescuco, remained incomplete until the beds had been searched for other fossils.

New nominations Nos. 1023 to 1028 were read.

A special Committee on the renovation of the oil paintings in the Hall, consisting of the Curators, with Mr. Phillips and Mr. Rothermel, was appointed and requested to report at the next meeting in June.

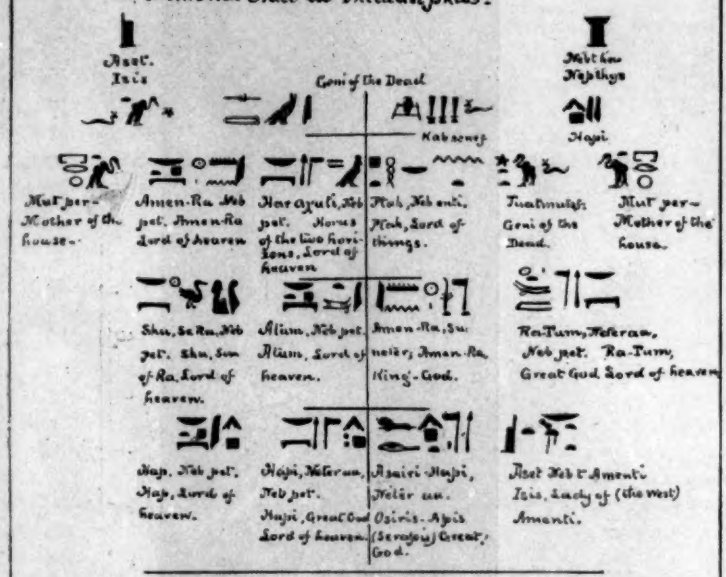
A resolution respecting the entertainment of the American Association for the Advancement of Science, by Mr. Fraley, was called up and passed.

And the meeting was adjourned.



Drawn by Com. E. Y. McCauley, U. S. N.

Inscription on a Mummy-case, of the XIX Dynasty, in Memorial Hall in Philadelphia.


Aset. Isis
Mut her Nephthys
Coni of the Dead.
Kabsenef
Hapi
Mut per- Mother of the house.
Amen-Ra Neb pet. Amen-Ra Lord of heaven
Har Aruti, Neb pet. Horus of the two horizons, Lord of heaven
Neb, Neb enti. Neb, Lord of things.
Tuatmutef: Coni of the Dead.
Mut per- Mother of the house.
Shu, Se Ra, Neb pet. Shu, Son of Ra, Lord of heaven.
Atum, Neb pet. Atum, Lord of heaven.
Amen-Ra, Sunnter; Amen-Ra, King-God.
Ra-Tum, Neferam, Neb pet. Ra-Tum, Great God, Lord of heaven
Hapi. Neb pet. Hapi, Lord of heaven.
Hapi, Neferam, Neb pet. Hapi, Great God Lord of heaven.
Asairi-Hapi, Neferum. Osiris-Apis (Serapis) Great, God.
Aset Neb t' Amenti Isis, Lady of (the west) Amenti.

Tat Satu sasp en Neb-Sekeri Usar Neferu Neb ru sti tat of
Royal gift of (to) Neb-Sekeri Socharis, Osiris God great, Lord mouth grave gave he
A royal oblation to the Neb-Secharis, the Osiris, Great God, Lord of the entrance to the land of

per-xenu apt, hpt-u arpu-u shet ari merh-u en ka as-
ceremonial, cloth, Beer, wines strong made, bowls, to Spirit
the grave; Hewas given for the ceremonial of the Dead' Bucks, Beeves Strong wines, for

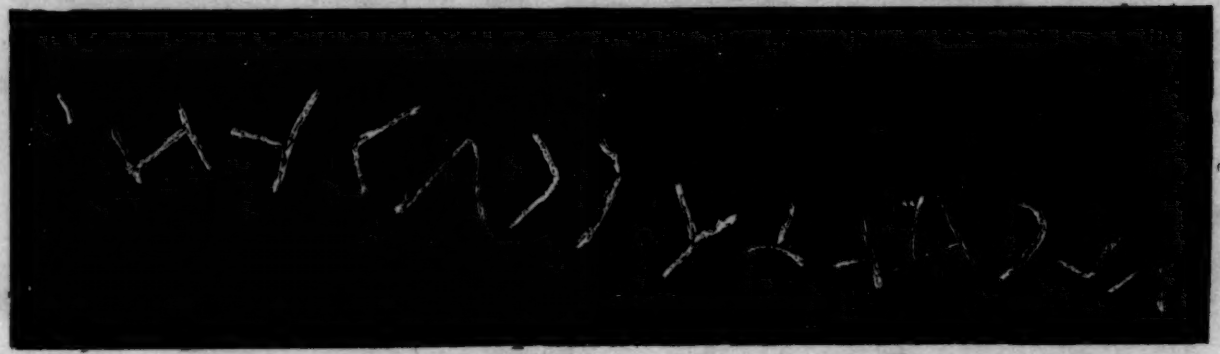
tati, en Ker sat en pehk mut per sat en
, of wheat, grease to mother house daughter of-
the Spiritual body of As-----tati; Also of wheat and grease to the Mother of the house,

her neter han Har.
Superior High Priest of Horus.
the daughter of the High Priest of Horus.

Drawn by Com. E. Y. McCauley, U. S. N.

Supposed Runic inscription near Yarmouth, Nova Scotia.

Photographed from a paper squeeze See Proc. Am. Phil. Soc. May 2nd 1884.



Scale of Inches 1 2 3 4 5 6 7 8 9

*On a supposed Runic Inscription at Yarmouth, Nova Scotia.** *By Henry Phillips, Jr.*

On the shore of the Bay of Fundy, opposite the town of Yarmouth, stands a rock weighing about four hundred pounds, which, about the end of the last century, was discovered by a man named Fletcher. It has been well known for nearly an hundred years, and those who dwell in its vicinity have always accepted it as a genuine relic of antiquity, no breath of suspicion ever having fallen upon it. The glyphs thereon have been at various times copied and sent abroad to men of learning who have made more or less attempts at deciphering them, more than one savant seeing traces of Semitic origin. In 1875, a rubbing procured from the stone was placed in my hands for investigation. Since that time I have carefully considered the circumstances of the case, and have become ultimately satisfied of its bona-fide nature, that the inscription was neither a modern fraud nor the work of the wayward playfulness of the leisure hours of the sportive red-skin. Having become imbued with a belief that no deception was intended, or practiced, I entered upon the study of the markings with a mind totally and entirely free from prejudice; so far from believing that the inscription was a relic of the pre-Columbian discovery of America, I had never given any credence to that theory. I therefore approached the subject entirely unbiassed in my opinion, in fact, somewhat prejudiced against the authenticity of any inscription on this continent, purporting to emanate from the hardy and intrepid Norsemen.

The difficulty of interpreting these markings was greatly increased on account of the nature of the material on which the rubbing had been taken, and the fact that in the Runic alphabets the letters frequently have many varying values and forms. But like as in a kaleidoscope, word after word appeared in disjointed forms, and each was in turn rejected until at last an intelligible word came forth, followed by another and another, until a *real sentence* with a meaning stood forth to my astonished gaze: *Harkussen men varu*, Hako's son addressed the men.

Upon examining further, I found that in the expedition† of *Thorfinn Karlsefne*, in 1007, the name of Haki occurs among those who accompanied him. I confess that I was staggered by the remarkable coincidence and began to waver, and the finishing touches were placed to my unbelief when I observed the map, and saw how short the distance was from Iceland to Greenland, compared with the stretch of water from Norway to Iceland. It seemed more than probable that the fearless race that actually did cross the latter expanse of ocean, were not likely to be deterred

*The squeeze of the inscription was made by Mr. T. B. Flint, Barrister at Law, of Yarmouth, N. S., and photographed by Mr. E. B. Harden, of Philadelphia.

† On this voyage "they came to a place where a firth penetrated far into the country. Off the mouth of it was an island, past which there ran strong currents, which was also the case farther up the firth."—Antiq. Americanæ, p. xxxi, Hafniæ 1837.

from navigating the former. As to the reason why such a memento should be left of the visit, of course no definite answer can be given, but it is a fact well known that memorials were often made or erected, engraved or placed at localities where events had taken place, and the address of the chieftain to the men may have been of some noteworthy matter, perhaps even to commemorate the fact of having landed at that spot.

In conclusion, I would say, that the circumstances are worthy of consideration, if not absolutely convincing.

On the Clinton and other Shales, &c., composing the Fifth Group of Rogers in the First Survey of Pennsylvania. By Prof. E. W. Claypole.

(*Read before the American Philosophical Society, March 21, 1884.*)

This group has been the field for considerable discussion in regard to the proper place of its different beds when compared with those supposed to be of similar or nearly similar age in New York. It has not been easy to prove where one formation began and another ended. By throwing all those shales into a single group Prof. Rogers avoided discussion on this point and No. 5 became a local or Pennsylvanian term. The group has the merit of being a very natural one regarded from a physical standpoint. Based on the massive Medina sandstone, and capped by the conspicuous Lewistown limestone, there was no question of its physical limits in the State, and all further differentiation was postponed.

But with the advance of geology, the necessity arises for closer comparison and correlation. It is not enough to suppose that the fifth group of Rogers corresponds with the New York beds between the top of the Medina sandstone, and the Lewistown or Lower Helderberg limestone. More exact division and definition are desirable, and my recent work in Perry county has put into my hands the means of examining this question in a new method—by the means of the fossils. Palæontology has hitherto done little towards its solution, and by palæontology alone in many cases can the true solution be reached.

In the present paper I propose to examine these rocks constituting the fifth group of Rogers, and to set forth the evidence thus far attainable, both stratigraphical and palæontological, for the places assigned to them among the palæozoic rocks.

The Clinton Group.

Beginning at the top of the Medina sandstone regarding the age of which there has been no question I will consider first the beds lying upon it in Perry county. These are shown in the following section:

Section of the Rocks in Perry County correlated with the Clinton Group of New York.

Fossil hæmatite and limestone		2 feet.
Sandrock		5 "
Hæmatite		1 "
Sandrock		5 "
Upper green shale	Shale, green	160 "
	Iron sandstone	2 "
	Fossil ore	1 "
	Shale, green	200 "
Iron sandstone		10 "
Hard fossil block ore		3 "
Lower green shale		600 "
		989

Medina sandstone.

The thickness here assigned to the different beds is not a constant quantity, and the diagram does not represent any actual section. It is, with this exception, accurate wherever the whole series crops out in the county. The measurements have been taken or estimated where it was possible to obtain them, and the details may be found in the forthcoming report on Perry county.

COMPARISON WITH THE CLINTON ROCKS OF NEW YORK.

Ft.	*New York.*	Ft.	*Perry Co., Pa.*
18.4	Limestone.	2	Limestone and hæmatite.
		5	Sandrock
		1	Hæmatite.
	Iron Ore.	5	Sandrock.
24.0	Upper green shale.	363	Upper green shale and fossil ore.
15.2	Iron ore and limestone.	13	Iron sandstone and fossil ore.
23.0	Lower green shale.	600	Lower green shale.
	Thickness, 80 ft. 6 inches.		Thickness, 989 feet.

POINTS OF DIFFERENCE.

Diversity of opinion may prevail in regard to the identity of the beds of iron ore on the above diagram, but this is of little moment. They are usually discontinuous and probably their horizons vary. This is the case even within the limits of Perry county and cannot therefore excite surprise at the distance of several hundred miles.

No sandstone is shown on the New York section and little limestone in Pennsylvania, but the sandstones in the latter are thin, only 10 and 20 feet thick respectively, and the same is true of the limestones of New York.

Beds so thin are not likely to be continuous over so great a distance. Such discrepancies are due to difference of conditions during deposition. They are no argument against correspondence.

Points of Resemblance.

It is impossible to avoid noticing the close correspondence, in general, between the two sections looked at as wholes. The lower parts of the two sections are absolutely identical except in thickness. And in Perry county the lower portion includes 965 feet out of the 989 which represent the total mass. In New York it includes 62 feet 2 inches out of the total 80 feet 6 inches. That is, practically, the column presents a close resemblance in the two sections through three-fourths of its length in New York and through forty-nine fiftieths of its length in Perry Co., Pennsylvania. Closer correspondence could not be looked for.

This reduction of its mass also brings the group in Pennsylvania into rather closer resemblance in thickness, to that which it possesses in New York. It is still vastly thicker, but this is the usual condition. If the whole of the shales of the fifth group be included the disproportion is enormous.

The resemblance can be traced even into more minute detail. Prof. Hall describes the *Lower green shale* as consisting of thin smooth laminæ containing lenticular masses of limestone. If sandstone be substituted for limestone, these words exactly describe the Lower green shale of Perry Co. Of the *Lower limestone* he says: "This mass is composed almost entirely of thin beds of impure limestone which alternate with thin layers of green shale." Again the change of the word will adapt the description to the iron sandstone and ore of Perry Co. Of the *Upper green shale* we read (p. 64): "This is readily distinguished from the Lower green shale by its being everywhere fossiliferous;" a statement also true of the two shales in Pennsylvania. The Lower has yielded me almost nothing, while from the Upper I have obtained a fair collection.

Stratigraphically, therefore, it is almost impossible to expect a closer agreement between two correlated beds than that which we actually find here. And unless contrary evidence be found elsewhere, it is not only a reasonable, but an inevitable inference that these beds must be considered equivalents.

Palæontological Evidence.

It is not possible at present to give in full the evidence furnished by palæontology in favor of the classification above adopted. The suspension or termination of the work of the survey in this department will delay for a considerable time the working out of the collection I have made and the making of a larger one. So far, however, as I have been able in the intervals of field work to study this material, it is decisively in favor of the views here set forth. A few details are appended, the parts of the group being taken in order.

Lower Shale.

Omitting the lower shale, in consequence of the scarcity of its fossils so far obtained, and the fact that there is no question of its affinity, I pass on to the next member of the series ascending.

Iron Sandstone and Block Ore.

The Iron sandstone is in some places very fossiliferous, and, aside from the fossils which relate to my present purpose, has yielded me some which promise to be of considerable interest to palæontology. Two species, however, bear on the present subject.

Beyrichia lata, Vanuxem.
Calymene Clintoni, Vanuxem.

Both are distinctly Clinton species described from that group in New York.

Upper Green Shale.

The three species already recognized from this bed are

Beyrichia lata, Vanuxem.
Calymene Clintoni, Vanuxem.
Claymene Niagarensis, Hall.

All are Clinton species in New York, the last extending its range into the Niagara group also.

Ore Sandrock.

This rock is in many places abundantly fossiliferous. Again we find

Beyrichia lata, Vanuxem.
Calymene Clintoni, Vanuxem.

Sandvein Ore Bed.

The same evidence comes from this horizon. I have recognized

Beyrichia lata, Van.
Calymene Clintoni, Van.
Ormoceras vertebratum, Hall.

Thus we find the results of a study of the fossils completely in harmony, so far, with those deduced from the stratigraphy. Clinton fossils range up to and into the Sandvein ore bed.

On the other hand in all these beds I have not yet found a single specimen belonging to any other horizon. Negative evidence is therefore confirmatory. We have consequently palæontological evidence, at present scanty, it is true, but unmistakable, of the persistence of the typical Clinton fauna of New York up to and through the Sandvein ore bed.

Limit of the Clinton Fauna.

At this horizon the Clinton fauna, pure and alone, altogether ceases. Above the Sandvein ore bed (or limestone in some places) comes a mass of green shale and thin hard limestone bands about 150 feet thick, in which fossils are scarce, but from which I have obtained a few species. Among these the only ones yet recognized with certainty are:

Lingula oblonga, Hall.
Beyrichia notata, Hall.

The former of these is a Clinton species in New York, and the latter was described from the Lower Helderberg rocks. We have here, therefore, a mingling of the faunas of the two groups indicating passage beds from one to the other.* This commingling of species is limited, so far as I have yet observed, to the belt of green shales and limestones above mentioned. Immediately over it lies the great (Bloomsburg) *Red shale*, which is almost barren, but which will be discussed below. Here it will suffice to observe that no Clinton forms have been found in it.

Palæontology, therefore, fully bears out the division above adopted for the lower part of this great mass of shales and sandstones, which have been hitherto thrown together into that Limbo of shale, No. 5 of Rogers. The arrangement deduced from the above train of reasoning is as given below:

Table of the Clinton group as proposed for Perry county.

	Onondaga group.	Red shale.
150	Passage beds.	Green shale and limestone.
989	Clinton group.....	Sandvein ore bed. Ore sandrock and hæmatite. Upper green shale and fossil ore. Iron sandstone. Hard fossil block ore. Lower green shale.
1139		

These beds are thus correlated, with those in the Report of the First Survey of Prof. Rogers (Vol. I, p. 132) of which they are here considered equivalent.

Onondaga.	Red shale.	Surgent red shale.
Passage beds.	Green shale and limestone.....	Surgent upper shale.
Clinton.....	Ore sandrock and ore.	Ore sandstone.
	Upper green shale and ore.....	Lower shale, Upper slate.
	Iron sandstone and ore.....	Iron sandstone.
	Lower green shale	Lower slate.

* Later examinations render probable the presence of several other Clinton forms in these green shales and limestones, which will give a more decidedly Clinton aspect to the fauna without invalidating the conclusions here reached.

The Onondaga Salt Group, or Gypseous Group of New York, in Perry County, Pa.

Having thus, in appearance, satisfactorily placed the lower portion of Rogers' fifth group on the horizon of the Clinton of New York, I proceed to consider its upper portion.

This, in the district under consideration, consists of a vast mass of shales with almost no variation, except that caused by a few thin layers of sandstone. These shales are red at base, but graduate upward with gray beds, the red color disappearing as we ascend through the series. The lower or red portion is about 700 feet thick, and the upper or gray portion about 150 or 200 feet. These are separated by about 700 feet of what have been called the variegated shales, consisting of alternate beds of red, green and ashen-gray color with a few interbedded sandstones.

It would be of course natural to correlate this shale with the limestone immediately overlying the Clinton in New York, but for reasons, which will appear presently, I have preferred to make it the equivalent of the Onondaga group of New York, which immediately overlies the Niagara, and thus to leave the latter unrepresented in Perry county.

Stratigraphical and Lithological Evidence.

The Onondaga group of New York consists, like that just described, of a mass of variegated shales, and, as some of its names imply, it there yields salt and gypsum. Its total thickness, given by Vanuxem in the Report of the Third District, is about 700 feet, and it is divided as shown below. The section in Perry county is given in another column for comparison.

New York.	*Perry County, Pa.*
Magnesian rock = Limestone with Stylolites.	
Gypseous bed (upper). Porous (vermicular) limerock. Gypseous bed (lower).	Gray, calcareous marl.
Variegated shale (red and green).	Variegated shale (red and green).
Red shale.	Red shale.
Thickness 700 feet.	Thickness 1600 feet.

Very close correspondence exists between the beds at the two places. At both they consist, at base, of a thick mass of red shale. At both, overlying the red shale is another mass of varying color. At both, these two beds form the bulk of the group. So closely do the two sections resemble one another, that the description given of these lower beds in New York may be copied and applied literally to those in Perry county.

Mr. Vanuxem says (Report on Third District of New York, p. 96) of the red shale:

"The great mass is of a blood-red color, fine-grained, earthy in fracture, breaking or crumbling into irregular fragments."

And of the variegated shale he says (p. 97):

"It consists of shales and calcareous slate of a light green and drab color, intermixing and alternating with the red shale at its lower part.

"Thus we have at the top of the series, green, then red under it, green, red, bluish, green and yellow, this latter by exposure to the air; then green and red layers with a little white and greenish sandstone, being several repetitions of the first two, and finally red shale as the lowest visible mass."

No better description can here be given of these two shales as they occur in Perry county.

The thickness of the separate beds is not given in Vanuxem's Report, but the total mass varies from 700 to 1000 feet. In Perry county the two lower masses—the red and variegated shales—measure 1400 feet, making the whole group, as usual, much thicker in Pennsylvania than in New York.

Again (p. 97.), "In several localities the red shale shows numerous green spots, varying from one inch or less to several inches in diameter.

"The red shale presents a thickness of from one to nearly 500 feet, yet nowhere has a fossil been discovered in it, or a pebble or anything extraneous, excepting a few thin layers of sandstone."

Similar green spots occur in the red shale in Perry county (near Wagoner's mill, for instance). The great scarcity of fossils is also remarkable, though these are not totally absent in Pennsylvania as will be mentioned farther on.

Advancing one step more let us compare the third division in Perry county with the similarly situated beds in New York. Here again we find the description of Vanuxem applicable to a great extent. He says (p. 99):

"The great mass of the deposit consists of rather soft, yellowish or drab and brownish colored shale and slate, both argillaceous and calcareous." It contains "argillaceous and calcareous slates, and more compact masses, which are hard." So in Perry county, though seldom exposed, this is the nature of the mass.

But one very important difference in these gray marls at the two places must be mentioned. No trace exists in this part of Pennsylvania of those concretions of gypsum which characterize the upper part of the Onondaga in New York, and which, together with its brine springs, render it the most valuable stratum in the State. These gray shales contain no valuable mineral, except the lime which enters largely into their composition. Such deposits as the gypsum and salt in New York rarely extend over very great tracts of country. Their absence in Perry county is not an objection sufficient to invalidate the argument. Indeed, the gypsum is not present over all the Onondagan outcrop in New York. Professor Hall says (Geol. of 4th District, p. 126), "There is a considerable space in the western part of Monroe county where no beds of gypsum are known."

Gypsum and salt, like iron ore, occur usually in scattered and discontinuous beds.

No closer correspondence can reasonably be looked for than that which I have here established between the Onondaga rocks in New York and those in Perry county, which I have placed in correlation with them. Only the uppermost stratum, called the Magnesian limerock, is unrepresented in the Pennsylvanian section. This is of inconsiderable thickness, measuring only twenty-four feet.

Palæontological Evidences.

The great barreness of these shales, which has been already alluded to, prevents the production of very strong evidence derived from their fossils. Only a single species bearing on the subject has rewarded a considerable amount of search. This is *Leperditia alta*, Conrad, which has been found in the Red shale in a few places abundantly, near Buffalo Mill, for example, in Saville township. It is also found in the second division—the Variegated shale—in Centre township, and becomes exceedingly abundant in its upper part, whole slabs being completely covered with its casts. These gray shales afford few opportunities of examination, but this species runs up into and through the massive limestones, forming in this county the lowest division of the Lower Helderberg rocks or Water Lime of New York. Above this horizon I have not found it.

In regard to this species Vanuxem says (l.c. p. 99):

"At one place only I succeeded in finding fossils in the second deposit (the Varigated shales), 'consisting of Cytherinæ' (Leperditiæ) about half the size of those in the group above."

In this respect, therefore, the correspondence is exact.

No fossils having been reported from the Red shale in New York, the presence of *Leperditia alta* in those of Perry county is not without interest, though it supplies no additional means of identification.

It has been mentioned that *Beyrichia notata* occurs in the passage bed below the Red shale. It may, therefore, be looked for in the Onondaga group, but I have not been able to find it. Its range, at present, is from the passage shales to the basal beds of the Lower Helderberg in Perry county, but it is yet known only in its extreme limits.

Summing up the evidence now presented, it is impossible to dispute the inference that the rocks above described are the real equivalent in Perry county of the Onondaga series in New York. By adopting this view, order is introduced into a mass of deposits hitherto the home of much confusion and uncertainty.

Below is added the correlation of these rocks with those of the First Survey.

Gray calcareous shale.	Scalent gray marls.
Variegated shale.	Surgent variegated marls.
Red shale.	Surgent red shale.

The Niagara Group of New York absent from Perry County, Pa.

From the identifications here established it follows that nothing is left to represent the Niagara group in Perry county. If such a representative existed it must lie on the top of the iron ore capping the Clinton group. But the green shale of the passage beds has yielded no fossils that can belong to a bed of that age. It holds, as above shown, a mingled fauna of the Clinton and Lower Helderberg ages. There is, consequently, no conclusion possible, except to infer the absence of the Niagara group from Perry county.

The rapid thinning of the Niagara rocks in New York to the eastward prepares us for this conclusion. Two hundred and forty feet thick at Niagara Falls, it dwindles down to about one hundred and thirty feet in Wayne county, near Rochester. No other exposure occurs until we reach the slope of the Cincinnati anticline in Southwest Ohio, where it scarcely exceeds fifty feet.

The Upper Limit of the Onondaga Group.

It is scarcely necessary to follow this subject further, as no doubt exists concerning the age of the mass of Limestone overlying these shales. The Lower Helderberg group in Perry county has a well-defined summit, being capped by the Oriskany sandstone, but an ill-defined base where it meets the Onondaga gray shales. Difference of opinion, consequently, may exist concerning the exact plane at which the separation should be made. A short statement, therefore, of the facts and argument bearing on this point is appended.

The Lower Helderberg rocks in Perry county as here defined, consist of the following :

10′	White flint shales.	*Oriskany Sandstone.*
80′	Yellow flint shales.	
8′	Black cherty limestone.	*Lower Helderberg* 348′.
150′	Lime shales.	
100′	Massive limestone.	*Onondaga Gray Shales.*

Regarding the age of all these beds, except the lowest, there is no room for doubt.* The Lime shales and the White flint shales both abound in the fossils that characterize the Lower Helderberg group in New York. The following partial list is sufficient to support this assertion.

Fossils Common to the Lime Shales of Perry County, Pa., and the Lower Helderberg Rocks of New York :

Discina discus, Hall.
† *Strophomena rugosa*, Dalman.
Rensselaeria mutabilis, Hall.
Rhynchonella nucleolata, Hall.
Rhynchonella formosa, Hall.
Merista lævis, Vanuxem.
Merista bella, Hall.
Megambonia aviculoidea, Hall.
Murchisonia minuta, Hall.

*This doubt is now removed by the note added below.

† This species and *Spirifera macropleura*, Con., abound in the White flint shale.

In regard to the lowest bed given in the section above, it must be admitted that in the determination of its horizon palæontology affords very little aid. Still palæontology is not our only guide in the solution of such problems. Indeed, she is only at best a guide whose authority is borrowed from stratigraphy, but nevertheless invaluable and indispensable.

COMPARISON OF THE LOWER HELDERBERG BEDS OF NEW YORK WITH THOSE REFERRED TO THAT GROUP IN PERRY COUNTY, PA.:

	New York.	*Perry County, Pa.*
Lower Helderberg.	Upper Pentamerus limestone.	
	Encrinital limestone.	Flint shales with Crinoids.
	Delthyris shaly limestone.	Lime shales.
	Lower Pentamerus limestone.	
	Water lime (Tentaculite bed.)	Massive limestone.
Onondaga	Magnesian rock.	
	Vermicular rock.	
	Gypseous marls.	Gray calcareous shale.

If the identifications previously made are accepted, there is no alternative but to admit the correlation of the Massive limestone with the Water lime, or to deny it any equivalent in the New York series. It is so closely connected with the overlying lime shales that to separate these would be in the highest degree illogical. They graduate into one another and can only be distinguished by the thinness of the beds and the abounding fossils of the upper strata. Their physical resemblance to the water lime is exceedingly great, but nowhere in Perry county have I been able to find any hydraulic beds. All slake equally when burnt.

PALÆONTOLOGICAL EVIDENCE.

In a case when stratigraphical evidence is so conflicting, the slight aid which palæontology can afford becomes exceedingly valuable. The Massive limestone being almost barren of fossils, the argument must rest on one or two species.

The Water lime is characterized in New York by abundance of *Leperditia alta*. As already mentioned, this fossil occurs for the last time, so far as yet observed in Perry county, in the massive limestone, where it is very abundant and often very large.

Occasionally, also, corals have been seen in this limestone, resembling species occurring in the lime shales above it, thus forming a link between the two. Below this limestone no fossils of this kind have been found in the shales.

Considering the high probability that this class of evidence would be increased by closer and wider search, especially in other counties, there can be no doubt that this Massive limestone should be included in the Lower Helderberg group of which it must then form the base. (See note, p. 502.)

If, however, any should prefer to relegate it to a system of "passage-beds" connecting the Onondaga and the Lower Helderberg, no valid objection can be raised to the course pending the discovery of further and conclusive evidence. It will not affect the arrangement above proposed.

I must remark in conclusion, that the suggestions now made are provisional, and therefore subject to change, according to future evidence. It does not seem probable, however, that the main outline of the plan will be altered.

Note. Since this paper was written I have obtained an excellent specimen of *Pterygotus Osborni*, Hall, from the massive limestone of Juniata county. This may be considered a proof of the identity of this limestone with the *Water lime* of New York. For this specimen I am indebted to Mr. Jas. Stevenson of this city (Akron, O.), a former resident of Juniata county, Pa.

SUMMARY OF THE GROUPING DETAILED ABOVE.

	New York.	*Perry County, Pa.*
Lower Helderberg Gr.	Upper Pentamerus limestone.	
	Encrinital limestone.	Flint shale with Crinoids.
	Delthyris shaly limestone.	Lime shales with *Tentaculites*, *Meristella*, &c.
	Lower Pentamerus limestone.	
	Water lime (Tentaculite bed).	Massive limestone with *Pterygotus* and *Lep. alta*.
Onondaga Gr.	Magnesian rock.	
	Vermicular rock.	
	Gypseous marls.	Gray, calcareous shale.
	Variegated shale.	Variegated shale.
	Red Shale.	Red shale.
		Passage-beds.
Clinton Group.	Limestone.	Limestone and hæmatite.
		Sandrock.
	Iron ore.	Hæmatite.
		Sandrock.
	Upper green shale.	Upper green shale and fossil ore.
	Iron ore and limestone.	Iron sandstone and fossil ore.
	Lower green shale.	Lower green shale.
	Medina sandstone.	

ERRATUM.

In Mr. Branner's paper on the growth of the Palm, for *Guilland*, read *Guillaud*; and for *Ser. VI, 176, 1877*, read, *Ser. V, 1—176 1877*.

5. All such communications shall be publicly read or exhibited to the Society at some stated meeting, not less than one month previous to the day of adjudication, and shall at all times be open to the inspection of such members as shall desire it. But no member shall carry home with him the communication, description, or model, except the officer to whom it shall be entrusted; nor shall such officer part with the same out of his custody, without a special order of the Society for that purpose.

6. The Society, having previously referred the several communications from candidates for the premium, then depending, to the consideration of the twelve Councillors and other officers of the Society, and having received the report thereon, shall, at one of their stated meetings in the month of December, annually, after the expiration of this current year (of the time and place, together with the particular occasion of which meeting due notice shall be previously given by public advertisement), proceed to final adjudication of the said premium; and, after due consideration had, a vote shall first be taken on this question, viz.: Whether any of the communications then under inspection be worthy of the proposed premium? If this question be determined in the negative, the whole business shall be deferred till another year; but if in the affirmative, the Society shall proceed to determine by ballot, given by the members at large, the discovery, invention or improvement most useful and worthy; and that discovery, invention or improvement which shall be found to have a majority of concurring votes in its favor shall be successful; and then, and not till then, the sealed letter accompanying the crowned performance shall be opened, and the name of the author announced as the person entitled to the said premium.

7. No member of the Society who is a candidate for the premium then depending, or who hath not previously declared to the Society that he has considered and weighed, according to the best of his judgment, the comparative merits of the several claims then under consideration, shall sit in judgment, or give his vote in awarding the said premium.

8. A full account of the crowned subject shall be published by the Society, as soon as may be after the adjudication, either in a separate publication, or in the next succeeding volume of their Transactions, or in both.

9. The unsuccessful performances shall remain under consideration, and their authors be considered as candidates for the premium for five years next succeeding the time of their presentment; except such performances as their authors may, in the meantime, think fit to withdraw. And the Society shall annually publish an abstract of the titles, object or subject matter of the communications, so under consideration; such only excepted as the Society shall think not worthy of public notice.

10. The letters containing the names of authors whose performances shall be rejected, or which shall be found unsuccessful after a trial of five years, shall be burnt before the Society, without breaking the seals.

11. In case there should be a failure, in any year, of any communication worthy of the proposed premium, there will then be two premiums to be awarded the next year. But no accumulation of premiums shall entitle the author to more than one premium for any one discovery, invention or improvement.

12. The premium shall consist of an oval plate of solid standard gold of the value of ten guineas. On one side thereof shall be neatly engraved a short Latin motto suited to the occasion, together with the words: "The Premium of John Hyacinth de Magellan, of London, established in the year 1786;" and on the other side of the plate shall be engraved these words: "Awarded by the A. P. S. for the discovery of——A. D.——." And the seal of the Society shall be annexed to the medal by a ribbon passing through a small hole at the lower edge thereof.

SECTION 2. The Magellanic fund of two hundred guineas shall be considered as ten hundred and fifty dollars, and shall be invested separately from other funds belonging to or under the care of the Society, and a separate and distinct account of it shall be kept by the Treasurer.

The said fund shall be credited with the sum of one hundred dollars, to represent the two premiums for which the Society is now liable.

The Treasurer shall credit the said fund with the interest received on the investment thereof, and if any surplus of said interest shall remain after providing for the premiums which may then be demandable, said surplus shall be used by the Society for making publication of the terms of the said premium, and for the addition, to the said premium, of such amount as the Society may from time to time think suitable, or for the institution of other premiums.

The Treasurer shall, at the first stated meeting of the Society in the month of December, annually, make a report of the state of said fund and of the investment thereof.